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Townsend et al.

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[54] **ELECTRONIC IDENTIFICATION SYSTEM**

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[51] **Int. Cl.**[4] **A01K 5/02**; G08B 13/24

[52] **U.S. Cl.** ..... **119/155**; 119/51 R; 340/572; 340/573

[58] **Field of Search** ..... 119/51 R, 155, 159; 340/572, 573

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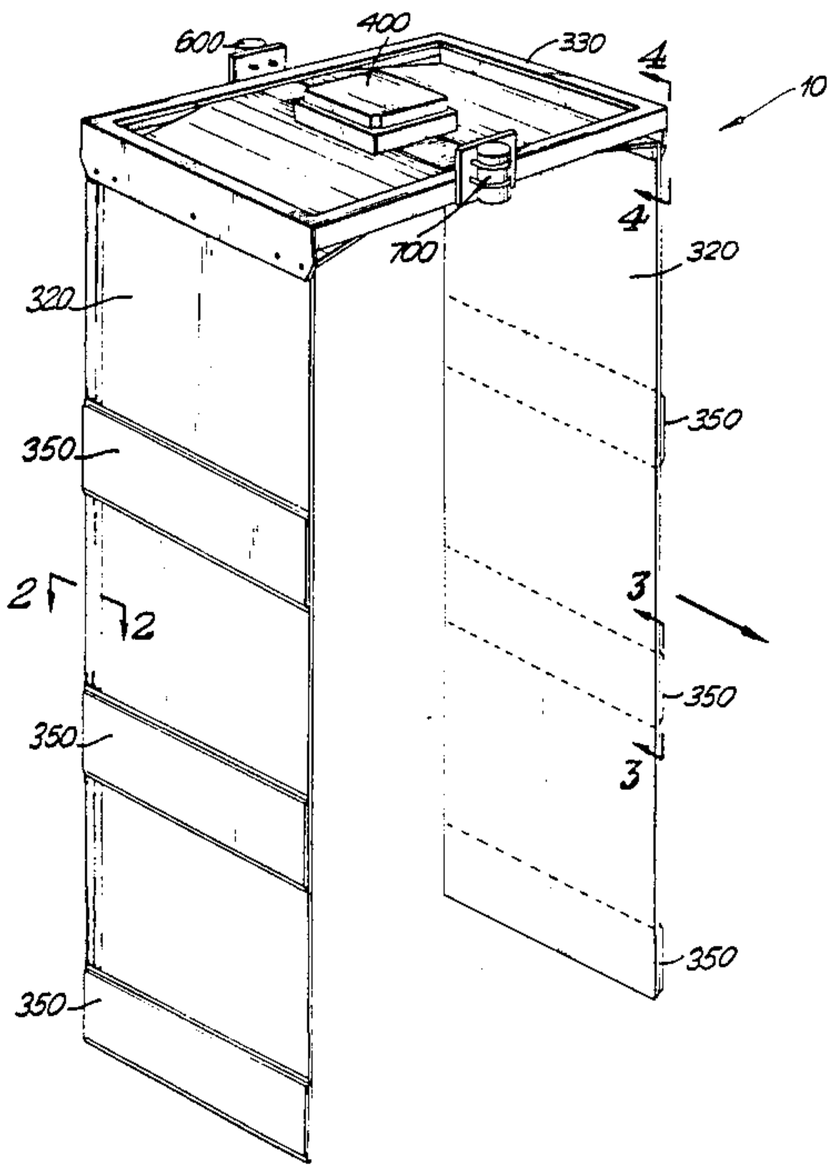
[57] **ABSTRACT**

An electronic identification system for identifying an animal moving through a portal structure is disclosed. A transponder worn on a rope or chain around the neck of the animal is energized by a multi-directional electromagnetic field generated by a double antenna loop in the portal structure. The transponder, when energized, will transmit identifying data back to the antenna loop after the electromagnetic field has been removed. That information will be processed by a microprocessor so that the animal can be identified. The antenna loop is secured within a flexible free-hanging curtain. The curtain is attached only at the top to the frame of the portal structure; the bottom of the curtain is free-hanging so that the curtain and antenna loop will not be damaged if the animal kicks the curtain. The system also includes two ultra-sonic transducers positioned at the entrance and exit of the portal. These two transducers are used to separately detect the presence of the animal in the portal structure and also to determine the direction of movement of the animal.

10 Claims, 7 Drawing Sheets



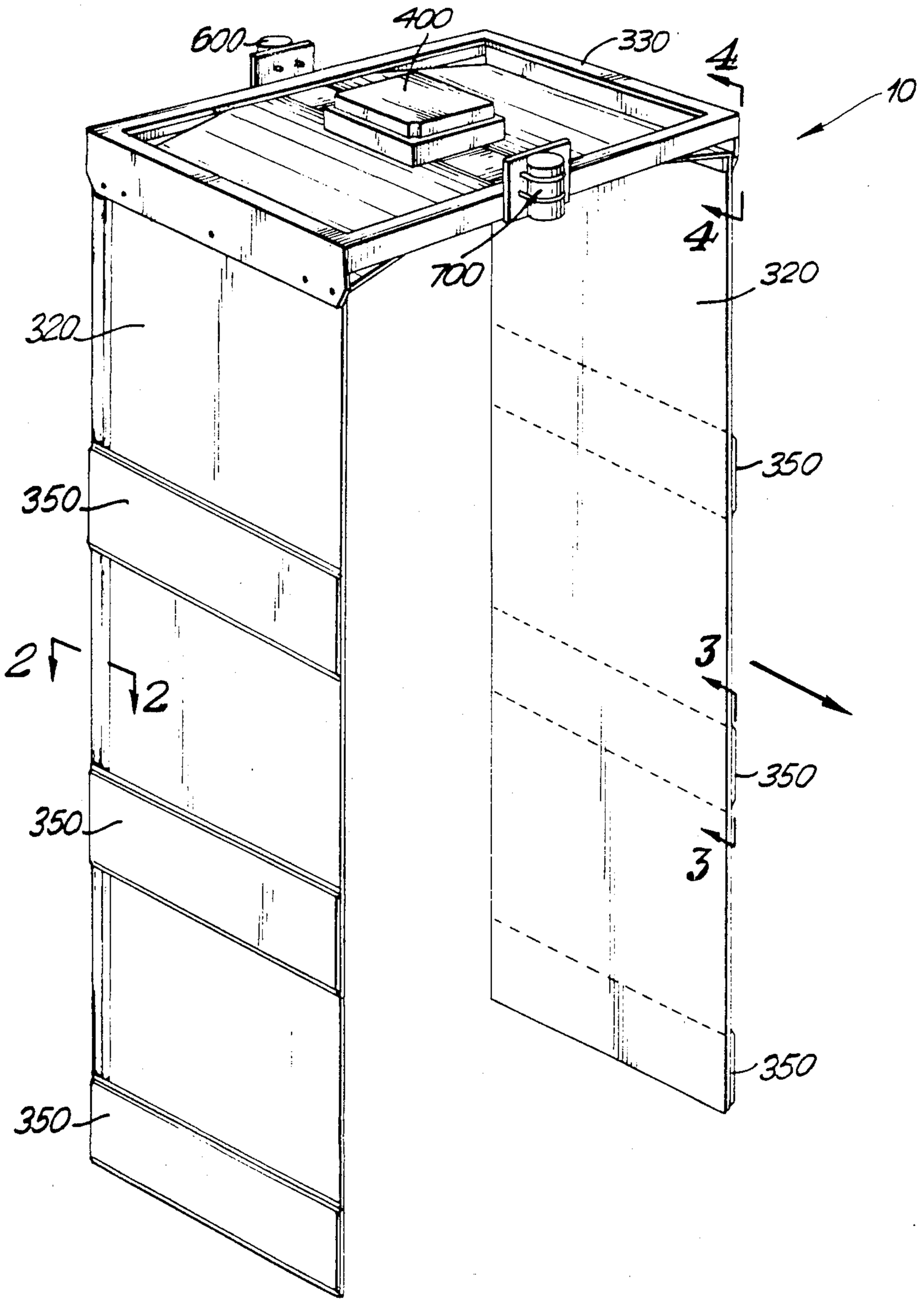


FIG.1

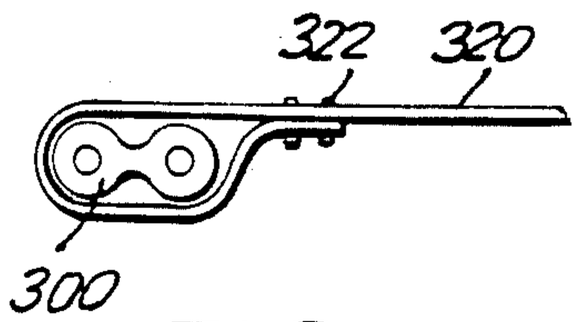


FIG. 2

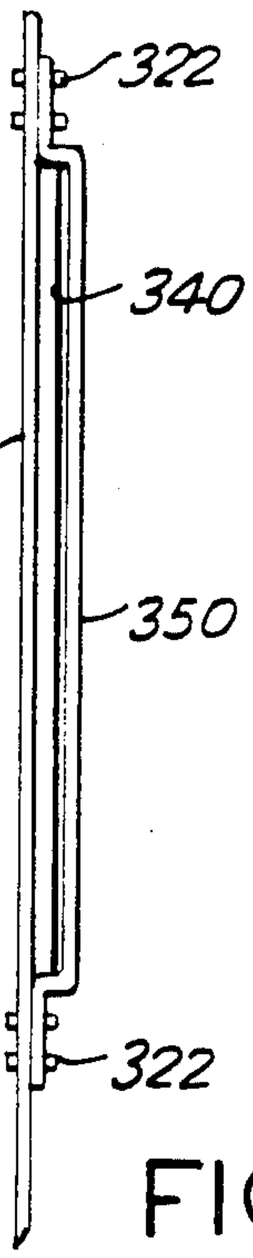


FIG. 3

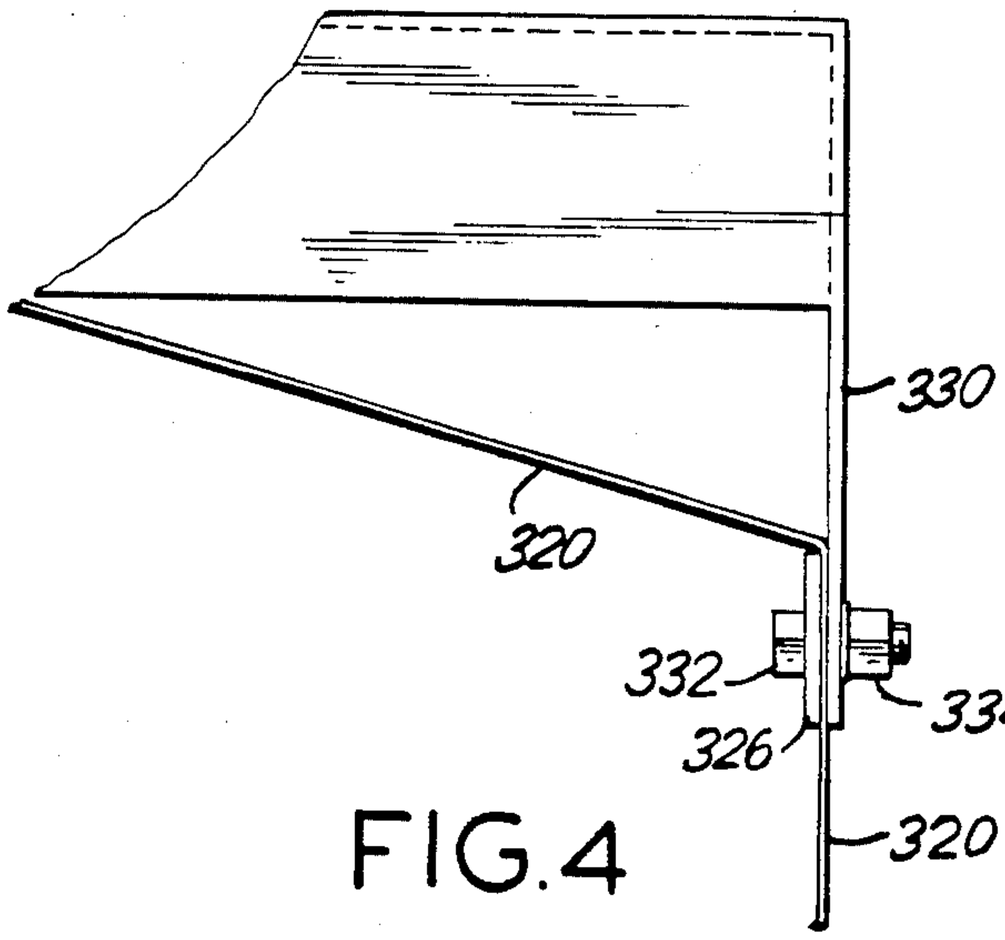


FIG. 4

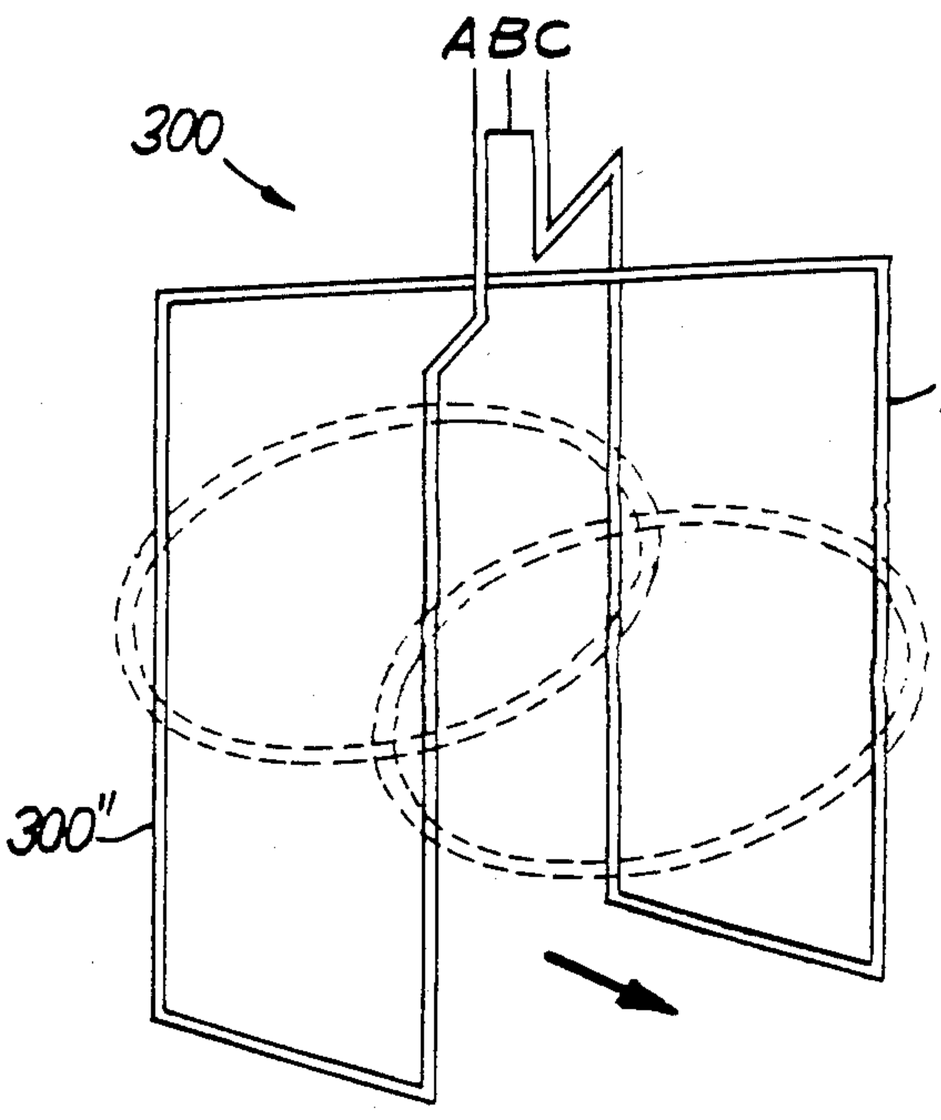


FIG. 5

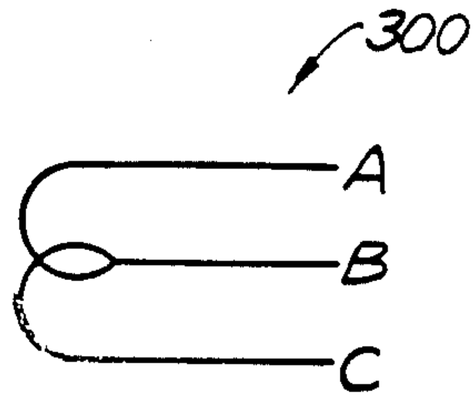


FIG. 5A

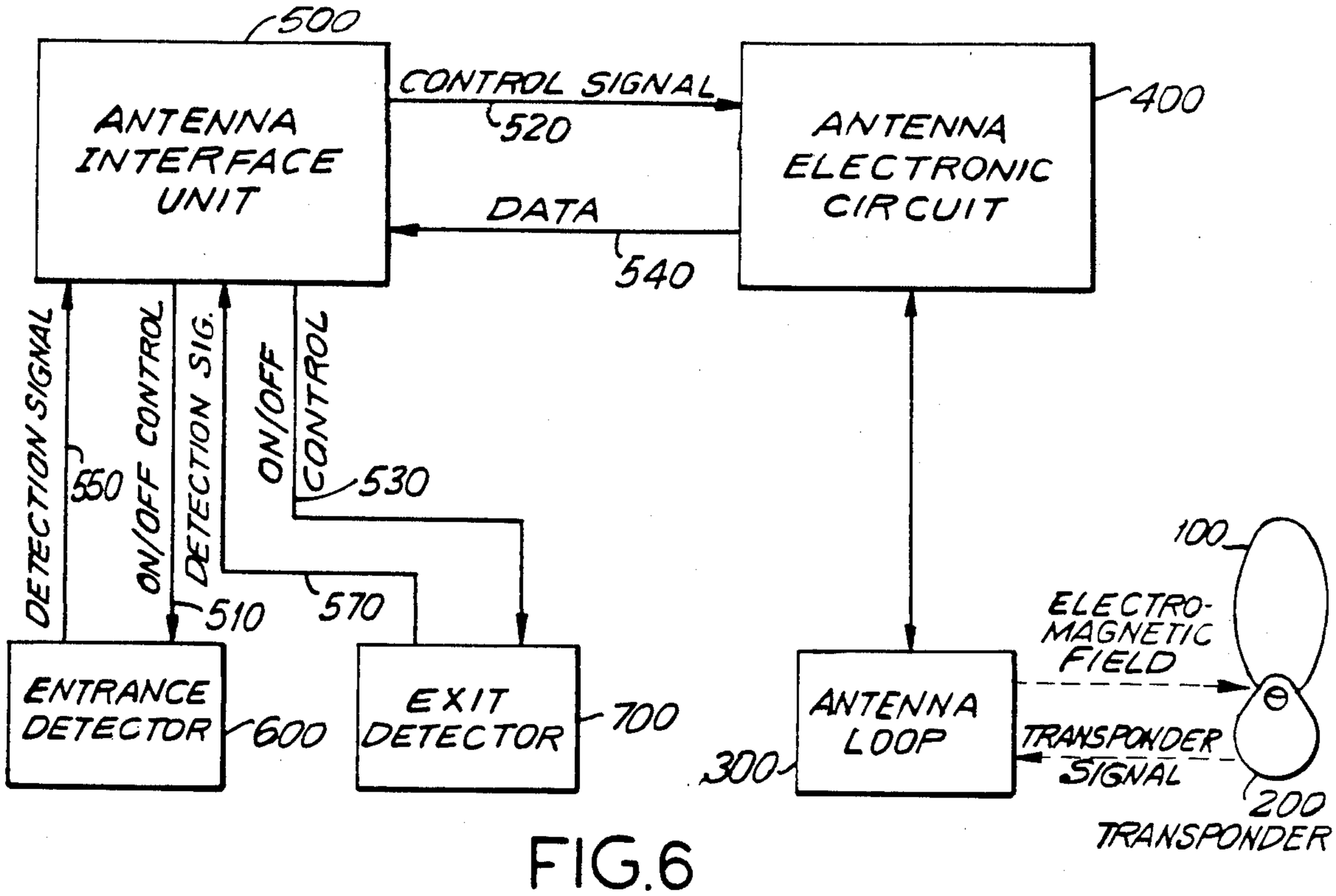

500
ANTENNA INTERFACE UNIT
CONTROL SIGNAL
520
DATA
540
400
ANTENNA ELECTRONIC CIRCUIT
DETECTION SIGNAL
550
ON/OFF CONTROL
DETECTION SIG.
510
ON/OFF CONTROL
530
570
ENTRANCE DETECTOR
600
EXIT DETECTOR
700
ANTENNA LOOP
300
100
ELECTRO-MAGNETIC FIELD
TRANSPONDER SIGNAL
200
TRANSPONDER

FIG.6

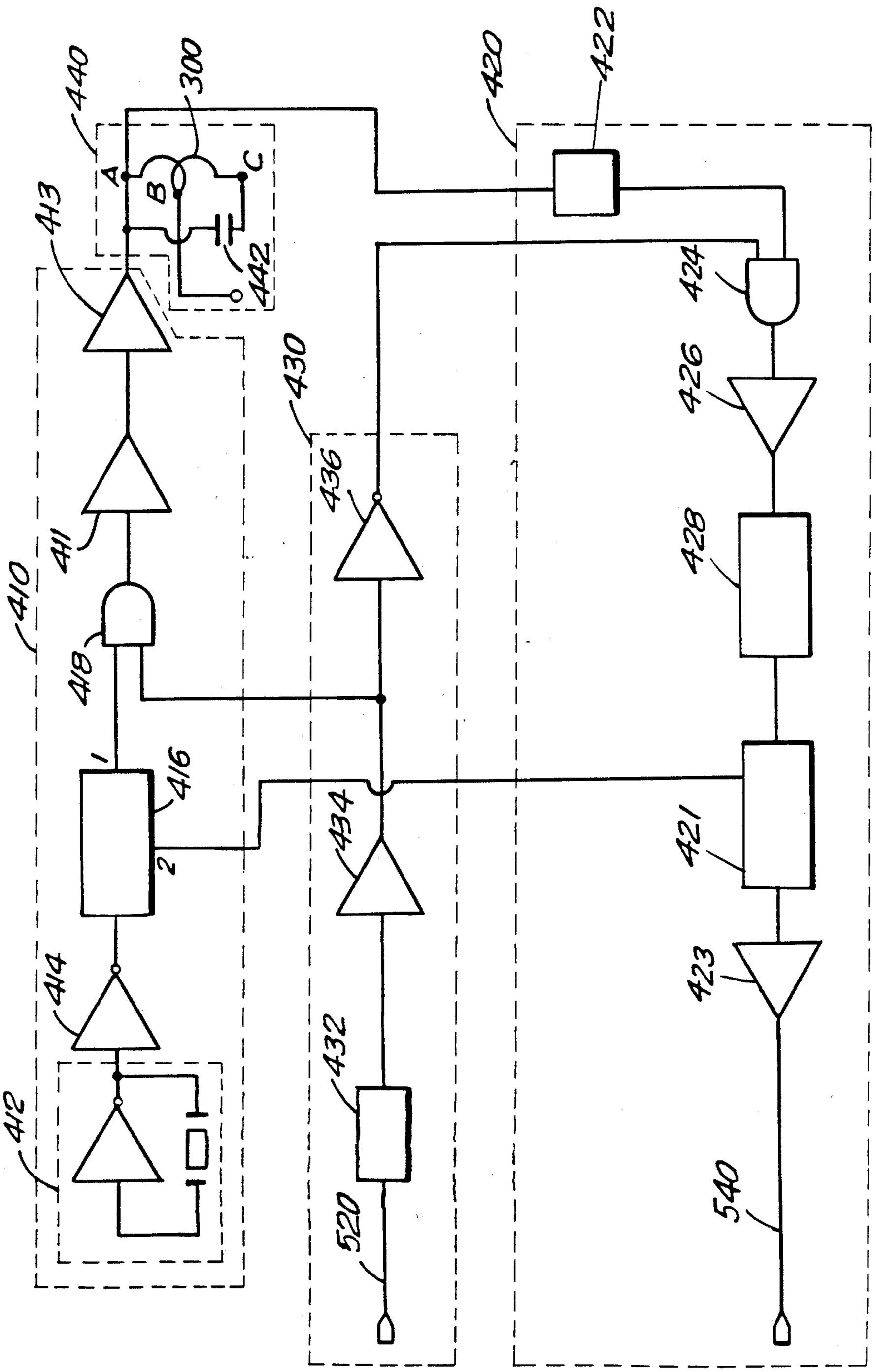

440
300
420
422
400
A
B
C
443
442
424
426
430
436
428
410
411
418
1
416
2
434
421
414
423
412
432
438
520
540

FIG.7

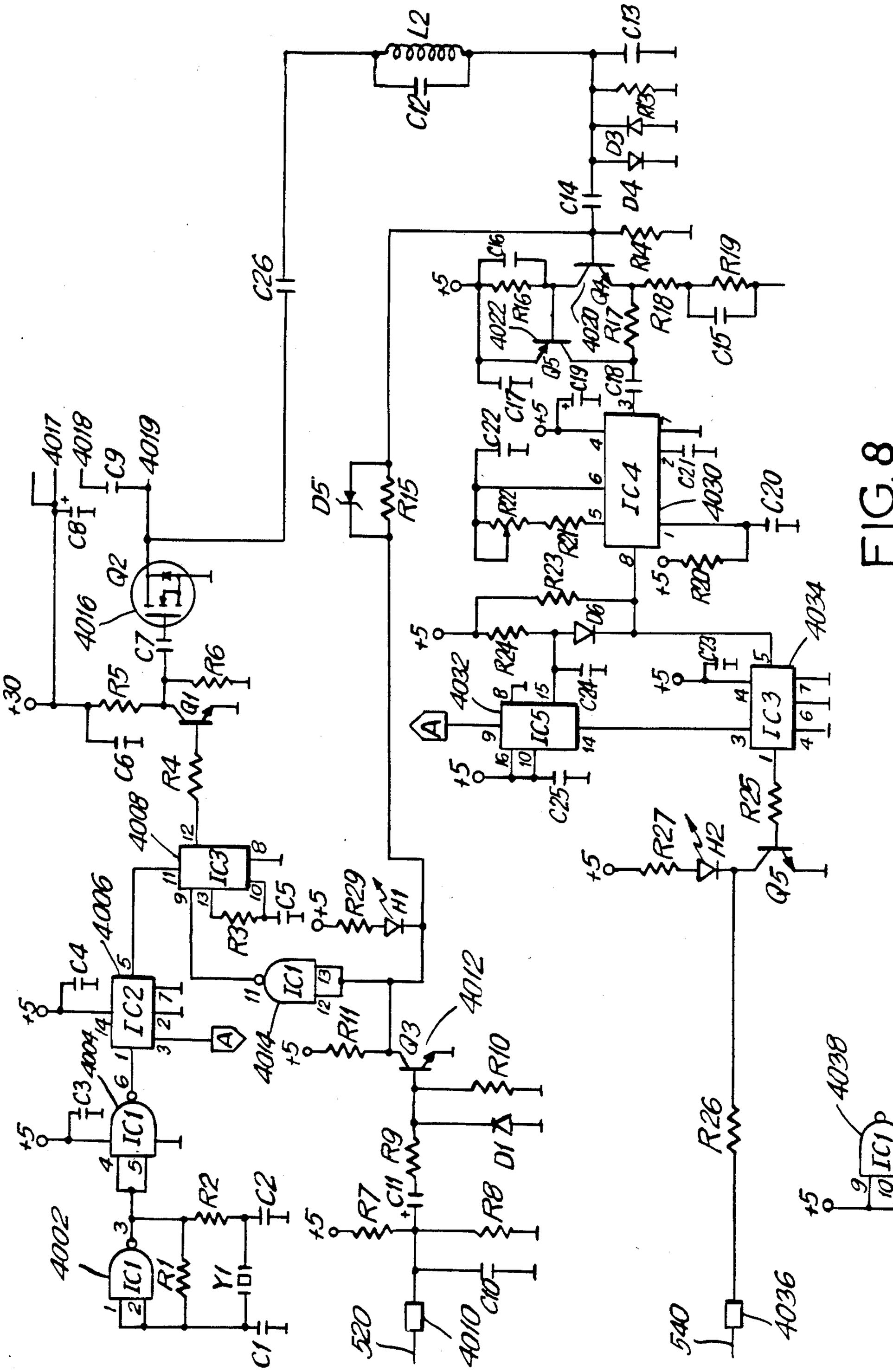

L2
C12
C13
R13
D3
D4
C14
R14
R19
R16
4022
4020
Q4
Q5
R17
R18
C15
C16
C17
C18
C19
C22
IC4
C21
4030
C20
R22
R21
R23
D6
D5
R15
4017
4018
C9
4019
C8
Q2
4016
C7
R6
R5
+30
C6
R4
4008
IC3
C5
R3
4006
C4
IC2
4004
C3
IC1
4002
R1
Y1
C1
C2
4012
Q3
R10
4014
R11
R29
H1
4032
IC5
C24
C23
4034
IC3
R25
R27
H2
Q5
R26
4036
540
R7
C11
R9
D1
R8
C10
4010
520
C26
A

FIG. 8

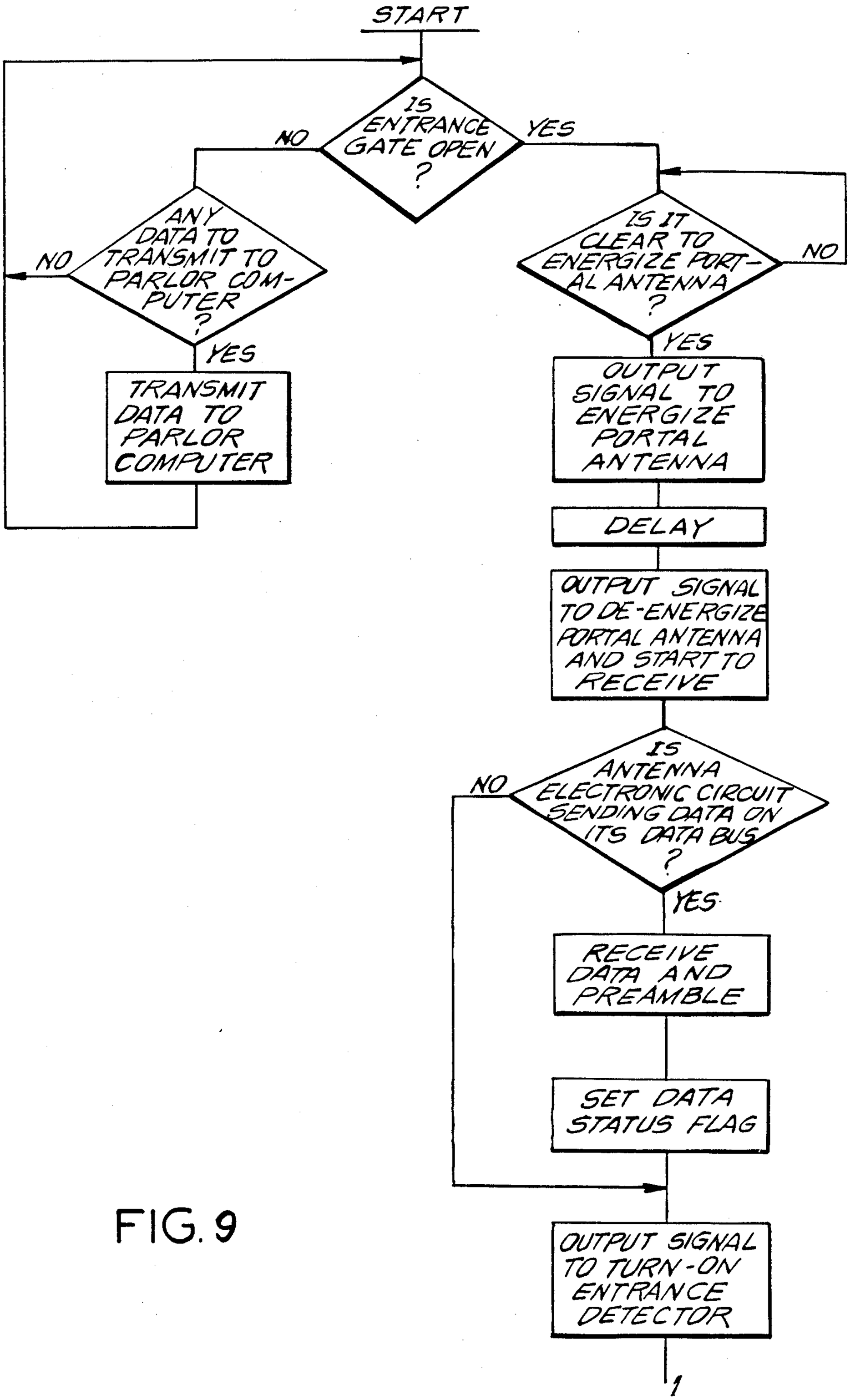

START
IS ENTRANCE GATE OPEN ?
NO
YES
ANY DATA TO TRANSMIT TO PARLOR COMPUTER ?
NO
YES
TRANSMIT DATA TO PARLOR COMPUTER
IS IT CLEAR TO ENERGIZE PORTAL ANTENNA ?
NO
YES
OUTPUT SIGNAL TO ENERGIZE PORTAL ANTENNA
DELAY
OUTPUT SIGNAL TO DE-ENERGIZE PORTAL ANTENNA AND START TO RECEIVE
IS ANTENNA ELECTRONIC CIRCUIT SENDING DATA ON ITS DATA BUS ?
NO
YES
RECEIVE DATA AND PREAMBLE
SET DATA STATUS FLAG
OUTPUT SIGNAL TO TURN-ON ENTRANCE DETECTOR
1

FIG. 9

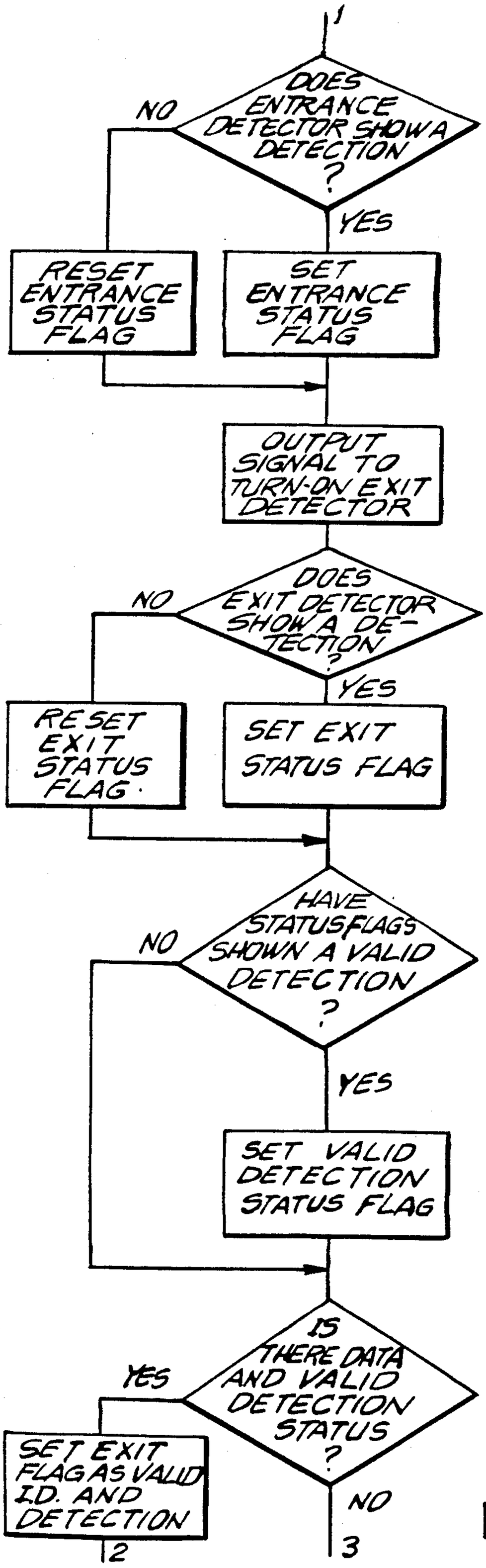

1
DOES ENTRANCE DETECTOR SHOW A DETECTION ?
NO
YES
RESET ENTRANCE STATUS FLAG
SET ENTRANCE STATUS FLAG
OUTPUT SIGNAL TO TURN-ON EXIT DETECTOR
DOES EXIT DETECTOR SHOW A DE-TECTION ?
NO
YES
RESET EXIT STATUS FLAG
SET EXIT STATUS FLAG
HAVE STATUS FLAGS SHOWN A VALID DETECTION ?
NO
YES
SET VALID DETECTION STATUS FLAG
IS THERE DATA AND VALID DETECTION STATUS ?
YES
NO
SET EXIT FLAG AS VALID I.D. AND DETECTION
2
3

FIG. 10

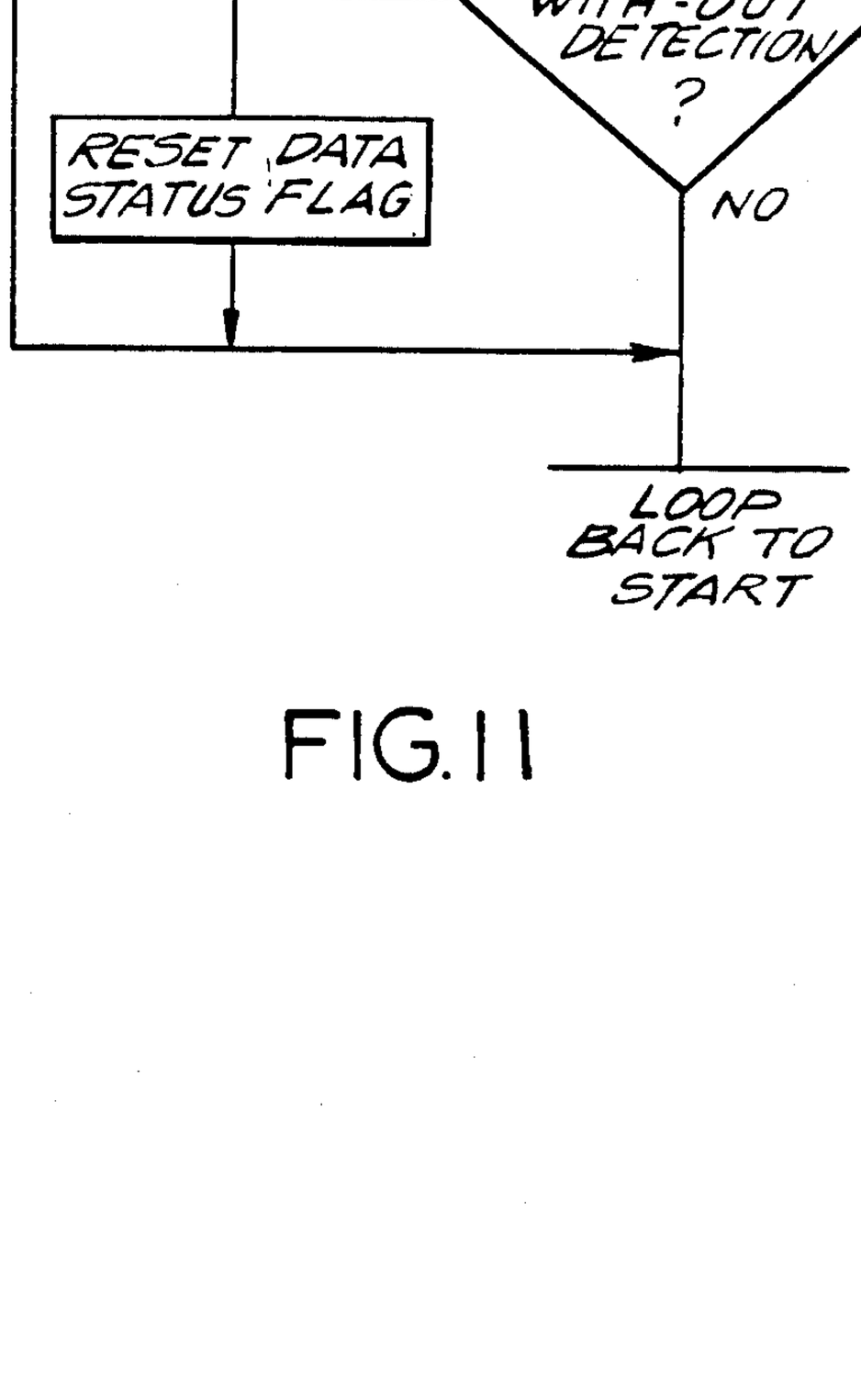

2
3
IS THERE VALID DETECTION STATUS ?
YES
NO
SET EXIT FLAG AS DETECTION WITH-OUT I.D.
IS THERE VALID I.D. WITH-OUT DETECTION ?
YES
NO
RESET DATA STATUS FLAG
LOOP BACK TO START

FIG. 11

ELECTRONIC IDENTIFICATION SYSTEM

FIELD OF THE INVENTION

This invention relates to an improved electronic identification system for identifying a moving object where the object is moving through a portal structure or the like.

BACKGROUND OF THE INVENTION

Accurate electronic identification of objects moving through an area is highly desirable. Electronic identification systems eliminate the need for visual monitoring of the objects by a person. Therefore, a greater volume of moving objects may move through the area of interest and still be detected. Further, because electronic identification systems can be adjusted to respond quickly to moving objects, the speed of movement of the moving objects may be increased without the electronic identification system losing the ability to identify the objects.

In the dairy industry such an electronic system is particularly useful. On a dairy farm a limited number of persons operate a milking parlor and many cows enter the parlor for milking in a short time. It is critical to know which cow is approaching the milking apparatus for milking, as the dairy farmer needs to be able to monitor, and also record, the daily milk output for each cow. Without a fast and accurate electronic identification systm, the milking parlor operator would have to visually identify each cow, thus causing extensive time delays in the milking procedure.

Prior attempts to electronically identify farm animals include U.S. Pat. to Carroll No. 4,475,481, issued Oct. 9, 1984, where a passive transponder device containing a coil is hung on a chain or rope around the animal's neck. For identifying an animal which is feeding, the '481 patent apparatus provides an identifier in the feeder box. The identifier has a coil driven by a power amplifier for transmitting energy to the coil in the transponder. The energized transponder then generates an RF signal containing unique identifying information relating to that animal. This signal containing identifying information is transmitted back to the identifier where it is decoded and sent to a computer, which then directs an auger in the feeder box to dispense the proper amount of feed for that particular animal.

A significant problem with the '481 patent apparatus is that the electromagnetic field generated by the identifier, which is used to energize the transponder, is oriented in only one direction, and therefore, if the animal turns his or her head **90°**, the axis of the coil in the transponder becomes perpendicular to the axis of the coil in the identifier, and there is insufficient magnetic coupling between the identifier and the transponder, resulting in a failure to energize the transponder and a consequent inability to identify the animal based on transponder-transmitted information.

The Carroll '481 apparatus also does not provide any separate means for sensing the presence of the animal in the feeder (apart from the transponder signal) or for sensing the direction of movement of the animal. Such information is of value as a check on the accuracy of any detection based on the presence of a transponder signal and allows for greater control and monitoring ability of a procedure involving a large number of moving objects, such as cows moving through a milking parlor.

SUMMARY OF THE INVENTION

The present invention is for an improved electronic identification system for identifying objects, particularly farm animals, moving through a portal structure. A double loop antenna generates a multi-directional electromagnetic field which is used to energize a transponder worn by the animal. When energized by the electromagnetic field, the transponder will transmit identifying data back to the antenna loop. A circuit decodes the identifying data and in conjunction with a microprocessor determines if the data is valid. Because of the configuration of the antenna loop, sufficient energy is radiated to the transponder and the transponder signal is received even if the axis of the transponder is changed due to a head movement of the animal or due to the animal entering the portal structure at an angle.

The antenna loop is secured within a flexible free-hanging curtain. The curtain is attached to a frame of the portal structure only at the top. Therefore, the bottom of the curtain is free-hanging and the curtain and antenna loop will not be damaged by a kick from the animal. Stiffener plates in pocket flaps of the curtain may be used to strengthen the curtain.

Two ultra-sonic detectors, one at the entrance to the portal structure and one at the exit to the portal structure, are used to separately detect the presence of an object in the portal structure. A microprocessor, by monitoring the two detectors or sequence, can also determine the direction of movement of the object through the portal structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing an embodiment of the electronic identification system of the present invention using a portal structure;

FIG. **2** is a top view of a portion of the antenna curtain of the portal structure along lines **2—2** of FIG. **1**;

FIG. **3** is a front elevational view of a portion of the antenna curtain of the portal structure along lines **3—3** of FIG. **1**;

FIG. **4** is a front elevational view of a portion of the frame of the portal structure along lines **4—4** of FIG. **1**;

FIG. **5** is a perspective view of the antenna loop within the antenna curtain of the portal structure of FIG. **1** showing as dotted lines the electromagnetic field generated by the antenna loop;

FIG. **5A** is a schematic representation of the antenna loop of FIG. **5**;

FIG. **6** is a block diagram of the identification system of the present invention;

FIG. **7** is a block diagram of the antenna electronic circuit of FIG. **6**;

FIG. **8** is an electrical schematic drawing of a portion of the antenna electronic circuit of FIG. **7**; and

FIGS. **9–11** are flow charts of software programs which may be used by the antenna interface unit shown in FIG. **6**.

DETAILED DESCRIPTION OF THE INVENTION

The electronic identification system of the present invention is described below, for exemplary purposes only, in terms of an embodiment for animal identification. It is readily apparent that the present invention may be used for any number of different identification

tasks, including identification of objects carried or worn by a person, wherein the object to be identified is moving through an area such as a portal structure.

Referring now by reference characters to the figures which illustrate an embodiment of the present invention, an animal such as a cow (not shown), wearing a chain, rope or strap **100** (FIG. **6**) containing a transponder **200**, moves through a portal structure **10** (FIG. **1**) in the direction of the arrow.

As the animal passes through the portal structure **10**, the transponder **200** receives energy at one frequency from an electromagnetic field (shown as dotted lines in FIG. **5**) generated by an antenna loop **300** contained within a curtain **320** in the portal structure **10**. After the circuitry in the transponder **200** is charged to a predetermined value, the electromagnetic field is removed, and the transponder **200** transmits identifying information concerning the animal, at a second frequency, back to the antenna loop **300**. This information is processed by an antenna electronic circuit (AEC) **400** (FIGS. **6, 7**) and an antenna interface unit (AIU) **500** (FIG. **6**). In an application of the present invention to a milking parlor, the AEC **400** and the AIU **500** are used to verify that the identifying information is valid and further assign the milk output to a particular cow.

Another feature of the identification system of the present invention is the detection of the presence and the direction of movement of the animal moving through the portal structure **10** using an ultra-sonic entrance detector **600** and an ultra-sonic exit detector **700**, which are both monitored by the AIU **500** as described in further detail below.

FIG. **6** shows in block diagram form the components of the identification system of the FIG. **1** embodiment, including the transponder **200**, the antenna loop **300**, the AEC **400**, the AIU **500**, the entrance detector **600** and the exit detector **700**.

The electromagnetic field (shown as dotted lines in FIG. **5**) develops a voltage in a parallel resonant circuit (not shown) of the transponder **200**. This resonant circuit, in the present embodiment, is tuned to the frequency of the transmitted voltage from the antenna loop **300**, e.g. a frequency of 131,072 Hz. Thus, the transponder **200** is charged in a conventional manner. As long as the electromagnetic field from the antenna loop **300** is present, the transponder cannot act as a transmitter. However, when the electromagnetic field is removed, the parallel resonant circuit of the transponder radiates a different frequency, e.g. a 98,304 Hz signal, to the antenna loop **300**, which acts as a receiver when the electromagnetic field is removed.

The radiated signal from the transponder **200** is a signal consisting of three parts. The first part is a preamble used to show the start of a transmitted message from the transponder **200**. The second part is a fixed delay period so that the AEC **400** and the AIU **500** have sufficient time to decode the preamble and determine whether a valid transponder signal (i.e., a signal corresponding to a known transponder) is being transmitted. Parts **1** and **2** of the transponder output signal are the same for all transponders.

The third part of the transponder signal is the unique identifying data for the particular animal. This identifying information in the present information consists of 14 data bits and a parity bit. This third part of the signal is unique for each transponder and is set by changing the program pins on an encoding chip (not shown) in the transponder **200**. Such encoding chips and the remaining circuitry in the transponder **200** are well-known in the art. The data from the transponder **200** is transmitted to the antenna loop **300** in the following order: preamble, delay period and identifying information.

After the transponder **200** has transmitted all three parts of the output signal, the transponder will cease to transmit any signals. Further energization of the transponder **200** by the antenna loop **300** will result in a repeat transmission by the transponder **200** of the three-part transponder signal.

Thus, as described above, the electromagnetic field generated by the antenna loop **300** energizes the transponder **200** with a signal at one frequency (e.g., 131,072 Hz) when the animal enters the portal structure **10**. When the electromagnetic field is removed, the energized transponder **200** transmits identifying information to the antenna loop **300** at a second frequency (e.g. 98,304 Hz).

In the identification system shown in U.S. Pat. No. 4,475,481, a problem develops if the animal (while wearing a transponder around the neck) turns his or her head when the head is in the feeder box. Because the electromagnetic field in the '481 patent generated by a coil in the identifier in the feeder box is oriented only in one direction, a turn in the animal's head causes the axis of the coil of the transponder to be nearly perpendicular to the axis of the coil in the identifier, resulting in insufficient electromagnetic coupling between the coil in the identifier and the pick-up coil in the transponder. Therefore, to achieve electromagnetic coupling sufficient to energize the transponder, the '481 patent apparatus requires a specified positioning of the transponder in relation to the identifier.

The present invention eliminates this problem because even if the animal turns his or her head when entering the portal structure **10**, or enters the portal structure **10** at an angle, the multi-directional configuration of the electromagnetic field, as shown by the dotted lines in FIG. **5**, permits maximum transfer of energy between the antenna loop **300** and the transponder **200** regardless of the angular orientation between the antenna loop **300** and the transponder **200**. Because antenna loop **300** generates electromagnetic fields in four angular relations to the direction of animal travel through the portal structure **10** (−90°, −45°, 45° and 90°), the transponder **200** will pick up enough energy to be energized even if the animal turns his or her head or enters the portal structure **10** at an angle. Similarly, when the antenna loop **300** receives identifying information from the transponder **200**, the multi-directional configuration of the antenna loop **300** insures that the antenna loop **300** receives enough of the transponder signal for identification purposes even if the animal turns his or her head.

Also, as seen in FIG. **5**, the antenna loop **300**, configured in a double loop arrangement, is present on both sides of the portal structure **10**. Therefore, the transponder **200** will be subjected to electromagnetic radiation from a left-hand loop portion **300'** of the antenna loop **300** and from a right-hand loop portion **300''** of the antenna loop **300** as the animal moves through the portal structure **10** in the direction of the arrow in FIG. **5**. This results in the transponder **200** receiving sufficient energy even if the animal does not enter exactly through the middle of the portal structure **10**.

The present invention, unlike the '481 patent apparatus, does not require the transponder **200** to be positioned in a certain fashion relative to the portal struc-

ture **10** to insure identification. Further, unlike the '481 patent apparatus, the present invention does not require the animal to be a specified distance from the antenna loop **300**, so long as the animal passes through the portal structure **10**.

FIG. **7** shows the block diagram form the antenna electronic circuit **400** (AEC). The AEC **400** has a transmission circuit section **410**, a receiver circuit section **420**, a control circuit section **430** and a parallel resonant circuit section **440**.

Transmission circuit **410** powers the parallel resonant circuit **440** so that the parallel resonant circuit **440** generates an electromagnetic field and radiates energy to energize the transponder **200**. When switched from the transmission mode to the receiving mode, the parallel resonant circuit **440** receives identifying information from the transponder **200**, and the receiving circuit **420** decodes that information and outputs it to the AIU **500** along data bus **540**. Control circuit **440**, under the direction of a control signal from the AIU **500** along control bus **520**, alternatively enables the transmission circuit **410** and the receiver circuit **420**, depending on whether the AEC **400** should be transmitting energy to energize the transponder **200** or receiving identifying information from the transponder **200**.

The transmission circuit **410** of the AEC **400** in the present embodiment operates as follows. The signal from a 4.194304 Mhz oscillator **412** is fed to a buffer **414**. The buffered signal is divided down by frequency divider **416**, with output **1** of the divider **416** at 131,072 Hz and output **2** at 32,768 Hz. Output **2** of divider **416** is used in the receiver circuit **420** of the AEC **400**, as described in more detail below.

The 131,072 Hz signal from output **1** of divider **416** is gated on and off in gate **418** by the control signal from driver **434**. The output from gate **418** is applied to a pulse shaper and driver **411**, whose output is applied to a power amplifier **413**. The output pulses from amplifier **413** drive the resonant circuit **440** (consisting of the antenna loop **300** and capacitor **442**) and cause the resonant circuit **440** to oscillate at a frequency of, e.g. 131,072 Hz.

The resonant circuit of the transponder **200** is tuned to this same frequency of 131,072 Hz. The electromagnetic field created by driving the resonant circuit **440** energizes the transponder **200** when the animal enters the portal structure **10** in the manner previously described.

As seen in FIGS. **5**, **5A** and **7**, the antenna loop **300** is center-tapped in order to double the voltage in the resonant circuit **440**, with point A of the antenna loop **300** connected to the output of amplifier **413** and capacitor **442**, point C connected to capacitor **442** and point B, the center-tap, connected to the supply voltage.

When the control circuit **430**, under the direction of a control signal from the AIU **500** along control bus **520**, turns off the transmission circuit **410**, the receiver circuit **420** is turned on. The receiver circuit **420** operates in the following manner. The transmitted identification signal from the transponder **200** is received by the resonant circuit **440**. That transponder signal passes through limiter **422** which excludes frequencies not of interest. The output signal from limiter **422** is gated on and off in gate **424** by a control signal from driver **436**. The output from gate **424** is then amplified by amplifier **426** and decoded by the decoder **428** which has an internal frequency equal to the transmission frequency of the transponder signal, e.g. 98,304 Hz. The tone decoder **428** converts the RF data burst signal to a digital level signal. If the input signal to the tone decoder **428** is not 98,304 Hz, indicating that the received signal is not a valid transponder signal, then no output signal is applied to a Manchester encoder **421**. However, if the frequencies are the same, then the tone decoded signal is coupled to the Manchester encoder **421**. As seen in FIG. **8**, output **2** from frequency divider **416** inputs into the Manchester encoder **421**. The encoder **421** is used to create a data transmission signal (consisting of a preample, time delay period and identifying information from the transponder) that can be transmitted to the AIU **500** through a driver **423** along data bus **540**. The AIU **500** can detect an error in this signal.

Control circuit **430** operates to control the transmission circuit **410** and the receiving circuit **420** in the following manner. When the AIU **500** wishes to instruct the AEC **400** to transmit energy to the transponder **200**, an appropriate signal on control bus **520** passes through protection circuit **432** and driver **434** to gate **412**, ultimately resulting in the driving of the resonant circuit **440** in the manner previously described. While the transmission circuit **410** is on, the receiver circuit **420** is off because driver **436** inverts the signal from driver **434**, and gate **424** will not pass the transponder-transmitted signal to the tone decoder **428**.

An appropriate change in the signal on control bus **520** from AIU **500** disables the transmission circuit **410** and enables the receiver circuit **420**.

FIG. **8**, which shows the components for a specific embodiment of FIG. **7**, has an oscillator **4002** and associated circuitry, followed by a buffer **4004** and a frequency divider **4006**. Output **5** of divider **4006** emits a signal with a frequency of 131,072 Hz to one-shot pulse generator **4008**. Output **3** of divider **4006**, a 32,768 Hz signal, is used in the receiving portion of the AEC **400**, as described below.

Generator **4008** will output an inverted output pulse provided that the control signal applied by the AIU **500** along control bus **520** to terminal **4010** is "high," resulting in the turning on of transistor **4012** and the inverting of the output from the collector of transistor **4012** by inverter **4014**. This "high" control signal at terminal **4010** turns on the transmission circuit **410** of the AEC **400**.

The output pulse from the generator **4008** is applied to the gate of MOSFET **4016**. As the MOSFET **4016** is pulsed on and off, the resonant circuit consisting of capacitor C9 and the center-tapped antenna loop (connected to terminals **4017**, **4018** and **4019**) oscillates at a frequency of 131,072 Hz.

As long as the transistor **4012** is on in response to an applied "high" control signal at terminal **4010**, the bias at transistor **4020** is removed and the receiver circuit of the AEC **400** is turned off.

The maximum time transistor **4012** can be turned on is limited by the time constant of capacitor C**11** and resistors R7 and R**8**. This time constant is for a longer duration than the control signal at terminal **4010** to insure that the control signal will control the operation of the transistor **4012**.

When the "high" control signal is removed from terminal **4010**, the transmission circuit of the AEC **400** turns off and the receiving circuit is turned on. The receiving circuit is turned on by virtue of the fact that when transistor **4012** is turned off, the bias voltage is reapplied to transistor **4020**.

When in the receiving mode, the antenna loop connected at terminals **4017**, **4018** and **4019** receives the transmitted transponder signal. That transponder signal is coupled through capacitor **C26** to the resonant circuit consisting of inductor **L2** and capacitor **C12**, which blocks any energy from the transmitter of the AEC **400** (when it is on) from reaching the receiver portion of the AEC **400**.

The received signal then passes through some limiting components and is applied to the amplifier circuit consisting of transistors **4020** and **4022** and related circuitry. The amplified signal is applied to the tone decoder **4030**, which operates in the manner described above for the decoder **428** of FIG. **7**. Resistor **R22** adjusts the internal frequency of decoder **4030** to a frequency of 98,304 Hz.

The Manchester encoder **421** of FIG. **7** is shown as integrated circuits **4032** and **4034** with related circuity. Integrated circuit **4032** also receives as an input the 32,768 Hz signal from output **3** of divider **4006**. The output data from this Manchester encoder scheme is outputted to the AIU **500** on data bus **540** at terminal **4036**.

Oscillator **4002**, buffer **4004**, inverter **4014** and circuit **4038**, in the present embodiment, are all part of one integrated circuit. Similarly, one-shot pulse generator **4008** and circuit **4034** are also part of a single integrated circuit.

Chart I below provides an identification of the components in FIG. **8**.

CHART I

Symbol	Value	Description
R1	47K	Resistor
R3,R7,R4	1K	Resistor
R11,R17	1K	Resistor
R2,R8,R23,R25	10K	Resistor
R19,R26	330	Resistor
R29	330	Resistor
R5	2.2K	Resistor
R9	1K	Resistor
R10,R15	100K	Resistor
R13	3.3K	Resistor
R14	56K	Resistor
R16	680	Resistor
R18	10	Resistor
R20	39K	Resistor
R21	3.9K	Resistor
R24	470K	Resistor
R27	470	Resistor
R22	1K	Variable resistor
C1	10 pf	Capacitor
C2	22 pf	Capacitor
C3,C4,C10	.1 mfd	Capacitor
C23,C25	.1 mfd	Capacitor
C8,C19	4.7 mfd	Tantalum capacitor
C9	.033 mfd	Capacitor
C11	22 mfd	Capacitor
C12	.0022 mfd	Capacitor
C13,C20	.0022 mfd	Capacitor
C22,C5	.0022 mfd	Capacitor
C14,C16	.01 mfd	Capacitor
C17,C21	.01 mfd	Capacitor
C15,C26	.22 mfd	Capacitor
C18	.001 mfd	Capacitor
C24	.047 mfd	Capacitor
C31	.0022 mfd	Capacitor
Q1,Q3,Q4,Q6	2N2222A	Transistor
Q5	2N2906A	Transistor
Q2	IRF730	MOSFET transistor
CR2	4.7 volt	Zener diode
D1,D3,D4,D6	IN4444	Silicon diode
D5	HBR130P	Schottky diode
IC1	74HC00N	Integrated circuit
IC2	74HC4024N	Integrated circuit

-continued

CHART I

Symbol	Value	Description
IC3	MC14013	Integrated circuit
IC4	LM567CN	Integrated circuit
IC5	MC14520	Integrated circuit
L2	680 μH	Inductor
H1		Green L.E.D.
H2		Yellow L.E.D.
Y1	4.194304 MHZ	Crystal

FIGS. **1–4** show in detail the portal structure **10**, and reference should be made to those figures in conjunction with the following description.

When used to monitor dairy cattle, the width of the portal structure **10** should be approximately 28", the height approximately 69" and the depth approximately 17". These dimensions permit cows of various sizes to easily walk through the portal structure **10**. The size of the portal structure **10** may be adjusted to accommodate animals or persons as required, and also may be configured to conform to the size requirements of the area surrounding the portal structure **10**.

The antenna loop **300**, having a left-hand portion **300'** and a right-hand portion **300"** (FIG. **5**) is contained within an antenna curtain **320**. The presence of the curtain **320** insures that the object moving through the portal structure **10** does not physically contact and possibly damage the antenna loop **300**. As seen in FIG. **2**, the antenna loop **300** is held within a fold of the curtain **320** by double-stitch sewing **322**. Any other suitable securing means for securing the antenna loop **300** within the curtain **320** may be used.

In the present embodiment, the curtain **320** is made of any suitable flexible material, such as a nylon reenforced vinyl.

The curtain **320** is secured to a rigid frame **330** of the portal structure **10** by a bolt **332**, attachment bar **326** and lockwasher **334**, as seen in FIG. **4**. The frame **330** may be secured to the ceiling of the building in which the portal structure is housed to insure that the portal structure **10** remains stationary. The curtain **320** hangs on each side of the portal structure **10**, secured on each side at the top to the frame **330** in the manner shown in FIG. **4**.

Each side of the curtain **320** is free-hanging at the bottom, i.e., each side of the curtain is not attached to any frame structure at the bottom. This free-hanging feature is particularly useful when animals pass through the portal structure **10** because the free-hanging curtain prevents the animal from damaging the antenna loop **300** or the portal structure **10** with a kick or other movement. If the animal does kick the curtain **320**, the curtain **320** will swing away, pivoted only at the top where it is attached to the frame **330**. It has been found that a free-hanging portal structure such as that shown in FIGS. **1–4** is less costly, requires less maintenance and has a longer service life than a rigid portal structure.

Stiffener plates **340** (one of which is shown in FIG. **3**) are positioned in each of pocket flaps **350** of the curtain **320**. The stiffener plates **340** help strengthen the curtain **320** and also result in a more stable hanging of the curtain **320**. The stiffener plates **340**, which in the present embodiment are made of polypropylene, do not interfere unduly with the flexible aspect of the curtain **320**.

In the present embodiment, the AEC **400** is secured to the top of the frame **330** of the portal structure **10** as shown in FIG. **1**. The AIU **500**, since it is connected to

the AEC **400** only by buses **520** and **540**, may be located any convenient distance from the portal structure **10**.

An additional feature of the identification system of the present invention is the apparatus for sensing the presence and the direction of movement of an object moving through the portal structure **10**. In the FIG. **1** embodiment, the sensing apparatus includes an entrance detector **600** and an exit detector **700**. Detectors **600** and **700** are both controlled by the AIU **500**.

The entrance detector **600** and the exit detector **700** are identical in operation, and therefore only the detector **600** will be described. The detector **600** includes an ultra-sonic transducer (not shown) which transmits and receives ultra-sonic signals. When instructed by the AIU **500** along control bus **510**, the entrance detector **600** will turn on and emit a short-burst, cone-shaped pattern of ultra-sonic sound waves. If an object is present within the cone, the sound wave will echo back and be received by the transducer. The received reflected ultra-sonic waves are the converted to an electrical detection signal by the detector **600** and transmitted to the AIU **500** along by **550**.

Because the AIU **500** only monitors the detector **600** along bus **550** for a short period of time after the transducer emits the ultra-sonic waves, sound waves which echo back to the transducer from the floor will not echo back to the transducer in time to be noted by the AIU **500**. Thus, the entrance detector **600** will only signal the presence of an object if in fact the object is within the cone emitted by the transducer of the detector **600**. The exit detector **700** operates in the same fashion as the entrance detector **600**, receiving control signals from the AIU **500** along control bus **530** and sending a detection signal to the AIU along bus **570**.

By monitoring the entrance detector **600** and the exit detector **700**, the AIU **500** can determine the presence of an object even without a signal from the transponder **200**. Also, the direction of movement of the object through the portal structure **10** may be determined.

Having a method to sense the presence of an object, separate from the identification signal from the transponder **200**, is of value. For instance, if a cow without a transponder or with an inoperative or defective transponder passes through the portal structure **10**, the detectors **600** and **700** will indicate that an object is present even though no transponder signal is received. Knowing that a cow has passed through the portal structure **10**, the AIU **500** can make sure that the milk output from that cow is not incorrectly assigned to another cow.

Information concerning the direction of movement is also useful, as a cow may become disoriented and walk back through the portal structure **10** instead of to the milking area. Noting a reverse direction of movement would confirm that a repeat identification signal from the transponder **200**, indicating the repeat presence of the same cow in the portal structure **10**, is not in error.

The AIU **500**, which in the present embodiment is a single board micro-computer based on the 8749H Intel computer chip, controls the AEC **400** and the detectors **600** and **700**. The operation in the present embodiment of the AIU **500**, in the context of a milking parlor, is shown in the flow charts, FIGS. **9–11**.

The AIU **500** first determines whether cows are approaching the portal structure **10**, for example by monitoring whether an entrance gate (not shown) leading to the portal structure **10** is open. If the entrance gate is open, the AIU **500** sends a control signal to the AEC **400** along control bus **520** directing the AEC **400** power the antenna loop **300** and thus create the electromagnetic field necessary to energize the transponder **200**, in the manner previously described.

After a certain delay period, the AIU **500** outputs a second control signal to the AEC **400** along control bus **520** instructing the AEC **400** to remove the electromagnetic field. The AIU **500** will then monitor data bus **540** to see if the AEC is sending a signal along that bus, indicating that the AEC **400** has received a signal from the transponder **200**.

If the AIU **500** determines that a signal on data bus **540** is a valid transponder signal the AIU **500** will decode this transponder signal. After the signal is decoded, the AIU **500** will send a signal on bus **510** instructing the entrance detector **600** to turn on. If the AIU determines there is not a valid transponder signal on bus **540** the AIU **500** will also send a signal on bus **510** instructing the entrance detector **600** to turn on. After a specified period, a signal is sent by the AIU **500** along bus **510** instructing the entrance detector **600** to turn off and the AIU **500** monitors bus **550** to determine if the detector **600** has detected the presence of an object. The AIU **500** then in similar fashion sends a signal on bus **530** instructing the exit detector **700** to turn on. After a specified period, a signal is sent by the AIU **500** along bus **550** instructing the exit detector **700** to turn off and the AIU **500** monitors bus **570** to determine if the detector **700** has detected the presence of an object. Based on an analysis of three signals, (1) the signal (if any) from the AEC **400** along data bus **540**, (2) the signal (if any) from entrance detector **600** along bus **550** and (3) the signal (if any) from detector **700** along bus **570**, the AIU **500** determines if a cow which can be identified has moved in the proper direction through the portal structure **10** to the milking area. If a cow has been identified, the milk output will then be assigned to the correct cow by a parlor computer (not shown) which is connected to the AIU **500**.

If the combination of signals indicate some unexpected occurrence, e.g., no valid transponder signal, no exiting from the portal structure **10**, incorrect direction of movement through the portal structure **10**, a sequential repeat of transponder codes, a valid transponder identification but no signals from the detectors **600** or **700**, etc., the AIU **500** will take appropriate action to insure that the milk output is not assigned to the wrong cow. Also, the AIU **500** can alert the milking parlor operator to the problems through audio and visual alarms or the like.

Multiple electronic identification systems of the present invention may be used for large scale identification operations, where all AIU units, each having a separate portal structure and AEC unit, are interconnected and a parlor computer controls all of the AIU units.

A detailed software listing for the flow chart of FIGS. **9–11** is attached hereto as Appendix A, and is part of the written disclosure of this application.

It will be understood that the identification system of the present invention is not limited to the embodiment described above, but rather is defined by the following claims.

APPENDIX A

```
M48 :F4:PRTPAT.ASM

IS-II MCS-48/UPI-41 MACRO ASSEMBLER, V4.0

LOC  OBJ          LINE      SOURCE STATEMENT
                    1 $PAGEWIDTH(80) PAGELENGTH(58)
                    2 ;PORTAL ID PROGRAM
                    3 ;
                    4 ;PROGRAM NAME PORTNT.ASM PORTAL ID UNIT
                    5 ;
                    6 ;          ***************************************
                    7 ;         **                                       **
                    8 ;        **            PORTAL ID UNIT               **
                    9 ;       **               8304479-02                  **
                   10 ;      **                  REV B                     **
                   11 ;      **          T. TOWNSEND AND C. MOORE          **
                   12 ;       **              APR.  1985                  **
                   13 ;        **                                         **
                   14 ;         ***************************************
                   15 ;
                   16 ;
                   17 ;*****************************************
                   18 ;
                   19 ;*****************************************
                   20 ;              CONSTANTS
                   21 ;*****************************************
00FB               22 UARTCA  EQU     0FBH     ;USART COMMAND ADDRESS
00FA               23 UARTDA  EQU     0FAH     ;USART DATA ADDRESS
009A               24 UARTMD  EQU     09AH     ;USART MODE WORD
0015               25 UARTCM  EQU     15H      ;USART COMMAND WORD
0000               26 KEYCMD  EQU     00H      ;8279 COMMAND WORD
00E0               27 KEYPSC  EQU     0E0H     ;8279 PRESCALER
00D0               28 KEYBLK  EQU     0D0H     ;8279 BLANKING COMMAND
00FD               29 KEYCA   EQU     0FDH     ;8279 CONTROL ADDRESS
00FC               30 KEYDA   EQU     0FCH     ;8279 DATA ADDRESS
007F               31 RAMT    EQU     7FH      ;TOP OF DATA MEMORY
0042               32 TIMEL   EQU     66       ;DISPLAY TIME  LOW
00F5               33 TIMEH   EQU     245      ;DISPLAY TIME HIGH
0090               34 DSCMD   EQU     90H      ;WRITE DISPLAY COMD
0007               35 DSEL    EQU     07H      ;DEVICE DESELECT CMD
FF83               36 IDTIME  EQU     -125     ;ID TIME (10 MSEC)
00FF               37 ON      EQU     0FFH     ;IDU ON COMMAND
0000               38 OFF     EQU     0        ;IDU OFF COMMAND
FFC4               39 GDLY    EQU     -60      ;GATE DELAY
00FF               40 OPEN    EQU     0FFH     ;GATE OPEN STATUS
0000               41 CLOSED  EQU     0        ;GATE CLOSED STATUS
                   42 ONCNT   EQU     -2       ;NUMBER OF ON COUNTS
```

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A conformed copy of the first page of Appendix A containing the following legend is attached hereto.

```
0040               47 PWRLIT  EQU     40H      ;POWER LIGHT LED #6
0020               48 GLIGHT  EQU     20H      ;GATE LIGHT  LED #5
FFFD               49 CNT1    EQU     -3       ;IDLE TIME = 5 SECONDS
FFD3               50 CNT2    EQU     -45      ;IDLE TIMER SECONDARY
                   51 ;
                   52 ;-----------------------------------------
                   53 ;                DATA MEMORY
                   54 ;-----------------------------------------
0000               55 REGB0:  DS      8        ;R0-R7 MAIN REGISTER BANK
0008               56 STACK:  DS      16       ;STACK MEMORY SYSTEM
0018               57 REGB1:  DS      8        ;R0'- R7' ALT REGISTER BANK
0020               58 IDADD:  DS      1        ;IDU ADDRESS LOCATION
```

```
0021                59 BCNT:    DS      1       ;BREQ COUNTER
0022                60 OUTBUF:  DS      6       ;UART OUTPUT DATA BUFFER
0028                61 OLDBUF:  DS      6       ;OLD OUTPUT BUFFER
002E                62 DSBUF:   DS      6       ;DISPLAY BUFFER
0034                63 INPTR:   DS      1       ;INPUT BUFFER POINTER
0035                64 INBUF:   DS      6       ;INPUT BUFFER
003B                65 CLKTIM:  DS      1       ;CYCLE TIMER
003C                66 UARTL:   DS      2       ;SERIAL PREAMBLE & DATA UART
003E                67 PREAMB:  DS      1       ;PREAMBLE FLAG
003F                68 DATLOW:  DS      2       ;TRANSP. RAW DATA
0041                69 BCDPTR:  DS      2       ;TRANSP. BCD DATA
0043                70 BINPTR:  DS      2       ;TRANSP BINARY DATA
0045                71 PARITY:  DS      1       ;TRANSP PARITY FLAG
0046                72 NEWDAT:  DS      2       ;NEW DATA POINTER
0048                73 OLDDAT:  DS      2       ;OLD DATA BUFFER
004A                74 IDCNTL:  DS      1       ;ID CONTROL FLAG LOCATION
004B                75 DVALID:  DS      1       ;DATA VALID FLAG
004C                76 HFBIT:   DS      1       ;HALF BIT FLAG
004D                77 IDBUF:   DS      32      ;IDBUFFER
006D                78 IDQUE:   DS      1       ;ID POINTER QUE
006E                79 BLCNT:   DS      1       ;BLANK TIME COUNTER
006F                80 STATUS:  DS      1       ;STATUS LIGHTS
0070                81 DFLAG:   DS      1       ;DETECT FLAG
0071                82 DSTAT:   DS      1       ;DISPLAY STATUS BUFFER
0072                83 PSTATE:  DS      1       ;PREVIOUS STATE BUFFER
0073                84 FAILB:   DS      1       ;DETECT FAILURE BUFFER
0074                85 PRESST:  DS      1       ;PRESENT STATUS
0075                86 TRCNTR:  DS      1       ;TRANSPONDER LOSS COUNTER
0076                87 IDFLG:   DS      1       ;ID FLAG
0077                88 DTIME:   DS      1       ;DETECT TIMER
                    89 ; NOTE: THESE LOCATION MUST REMAIN SEQUENTIAL
0078                90 ONDLY1:  DS      1       ;SONAR #1 ON DELAY
0079                91 ONDLY2:  DS      1       ;SONAR #2 ON DELAY
007A                92 OFDLY1:  DS      1       ;SONAR #1 OFF DELAY
007B                93 OFDLY2:  DS      1       ;SONAR #2 OFF DELAY
007C                94 IDLECT:  DS      1       ;IDLE TIMER
007D                95 IDLEC2:  DS      1       ;IDLE TIMER (SECONDARY)
                    96 ;
                    97
                    98 $EJECT
                    99 ;
                   100 ;
                   101 ;-----------------------------------------------------
                   102 ;                   START OF INIT
                   103 ;-----------------------------------------------------
0000               104          ORG     00H
0000 0409          105          JMP     START           ;RESTART ADDRESS
0003               106          ORG     03H             ;EXT INT ROUTINE
0003 04FD          107          JMP     EXTINT
0007               108          ORG     07H             ;INT TIMER INIT
0007 2400          109          JMP     TIMINT          ;ROUTINE
                   110 ;
                   111 ;
0009 C5            112 START:   SEL     RB0
000A 75            113          ENT0    CLK ;
000B 2300          114          MOV     A,#00
000D D7            115          MOV     PSW,A
000E 37            116          CPL     A
000F 3A            117          OUTL    P2,A
0010 39            118          OUTL    P1,A
0011 00            119          NOP
0012 00            120          NOP
0013 00            121          NOP
0014 9AF7          122          ANL     P2,#0F7H
                   123 ;--------------------CLEAR ALL RAM-----------------
0016 B87F          124 STRT1:   MOV     R0,#RAMT
0018 BA5E          125          MOV     R2,#RAMT-33
001A 2300          126          MOV     A,#00
001C A0            127 CLRDAT:  MOV     @R0,A
001D C8            128          DEC     R0
001E EA1C          129          DJNZ    R2,CLRDAT
                   130 INIT51:
0020 9AF3          131          ANL     P2,#0F3H
0022 2300          132          MOV     A,#00H
```

```
0024 91          133          MOVX    @R1,A
0025 91          134          MOVX    @R1,A
0026 91          135          MOVX    @R1,A
0027 2340        136          MOV     A,#40H
0029 91          137          MOVX    @R1,A
002A 239A        138          MOV     A,#09AH
002C 91          139          MOVX    @R1,A          ;INITIALIZE 8251
002D 2315        140          MOV     A,#15H
002F 91          141          MOVX    @R1,A
0030 00          142          NOP
0031 00          143          NOP
0032 8A07        144          ORL     P2,#DSEL
                 145 ;
0034 9AFD        146 INIT79:  ANL     P2,#KEYCA      ;INITIALIZE 8279
0036 2300        147          MOV     A,#KEYCMD
0038 91          148          MOVX    @R1,A
0039 2320        149          MOV     A,#KEYPSC
003B 91          150          MOVX    @R1,A
003C 23D0        151          MOV     A,#KEYBLK
003E 91          152          MOVX    @R1,A
003F 8A07        153          ORL     P2,#DSEL       ;DESELECT DEVICE
0041 05          154          EN      I
0042 B821        155          MOV     R0,#BCNT
0044 B0FA        156          MOV     @R0,#0FAH      ;INIT BREQ COUNTER
0046 B84A        157          MOV     R0,#IDCNTL
0048 B0FF        158          MOV     @R0,#ON        ;SET ID CONTROL ON
004A B8EE        159          MOV     R0,#BLCNT
004C B0D3        160          MOV     @R0,#BCOUNT    ;INIT BLANK COUNTER
004E BC20        161          MOV     R4,#32
0050 B84D        162          MOV     R0,#IDBUF
0052 B0FF        163 IDCLR:   MOV     @R0,#0FFH      ;CLEAR IDBUFFER
0054 18          164          INC     R0
0055 EC52        165          DJNZ    R4,IDCLR
0057 B86D        166          MOV     R0,#IDQUE
0059 B000        167          MOV     @R0,#0         ;CLEAR POINTER
005B B871        168          MOV     R0,#DSTAT
005D B004        169          MOV     @R0,#04H       ;CLEAR DETECT STATUS
005F B874        170          MOV     R0,#PRESST     ;LIGHTS AND TURN ON
0061 B000        171          MOV     @R0,#00        ;POWER LIGHT
0063 B872        172          MOV     R0,#PSTATE
0065 B001        173          MOV     @R0,#01H       ;PREVIOUS STATE = 1
0067 B875        174          MOV     R0,#TRCNTR     ;FOR START-UP
0069 B0FE        175          MOV     @R0,#TRCNT     ;TRANSPONDER COUNTER
006B B873        176          MOV     R0,#FAILB      ;SET FAILED BUFFER
006D B000        177          MOV     @R0,#00H
006F B877        178          MOV     R0,#DTIME
0071 B0FE        179          MOV     @R0,#DCOUNT
0073 B878        180          MOV     R0,#ONDLY1
0075 B0FE        181          MOV     @R0,#ONCNT
0077 18          182          INC     R0
0078 B0FE        183          MOV     @R0,#ONCNT
007A 18          184          INC     R0
007B B0FE        185          MOV     @R0,#OFCNT     ;INITIALIZE COUNTERS
007D 18          186          INC     R0
007E B0FE        187          MOV     @R0,#OFCNT
0080 B87C        188          MOV     R0,#IDLECT
0082 B0FD        189          MOV     @R0,#CNT1      ;INITIALIZE SHME LOW
0084 B87D        190          MOV     R0,#IDLEC2     ;TIMER
0086 B0D3        191          MOV     @R0,#CNT2
0088 B400        192          CALL    BLKDIS         ;CLEAR DISPLAY AND
                 193                                 ;CHECK SONAR
                 194 ;
                 195 ;
                 196 ;  START FOREGROUND ROUTINES
                 197 ;
                 198 ;-----------------------------------------------
                 199 ;                FOREGROUND ROUTINES
                 200 ;-----------------------------------------------
                 201 ;
                 202 FORE:
008A B8EE        203          MOV     R0,#BLCNT
008C 10          204          INC     @R0
008D F0          205          MOV     A,@R0
008E 9694        206          JNZ     FORE0
```

```
0090 B0D3          207          MOV     @R0,#BCOUNT
0092 B400          208          CALL    BLKDIS
                   209 FORE0:
0094 B493          210          CALL    IDTST
0096 9489          211          CALL    GTEST          ;TEST IF GATE OPEN
0098 FC            212          MOV     A,R4           ;YES- GO TURN-ON LOOP
0099 C6A6          213          JZ      FORE0A
009B 54B7          214          CALL    DELAY          ;NO- DELAY 50 MS
009D B846          215          MOV     R0,#NEWDAT
009F B099          216          MOV     @R0,#99H
00A1 18            217          INC     R0
00A2 B099          218          MOV     @R0,#99H       ;INITIALIZE ID
00A4 048A          219          JMP     FORE
00A6 99BF          220 FORE0A:  ANL     P1,#0BFH
00A8 00            221          NOP
00A9 00            222          NOP
00AA 9AFB          223          ANL     P2,#UARTCA
00AC BC14          224 FOREA:   MOV     R4,#20
00AE 81            225 FOREB:   MOVX    A,@R1
00AF 37            226          CPL     A              ;CHECK FOR ACTIVE
00B0 F2AC          227          JB7     FOREA          ;RECEIVERS
00B2 ECAE          228          DJNZ    R4,FOREB       ;CHECK FOR VALID
00B4 8A07          229          ORL     P2,#DSEL       ;INACTIVE
00B6 993F          230          ANL     P1,#3FH
00B8 8940          231          ORL     P1,#40H        ;TURN CONTROL ON
00BA BD02          232 FORE1:   MOV     R5,#2
00BC 94A6          233 FORE2:   CALL    OUTST
00BE EDBC          234          DJNZ    R5,FORE2
00C0 B875          235          MOV     R0,#TRCNTR
00C2 10            236          INC     @R0
00C3 F0            237          MOV     A,@R0
00C4 96CE          238          JNZ     FORE3
00C6 B0FE          239          MOV     @R0,#TRCNT     ;RELOAD TRANSP LOSS
 00C8 B874         240          MOV     R0,#PRESST     ;COUNTER
 00CA F0           241          MOV     A,@R0
 00CB 53FE         242          ANL     A,#0FEH
 00CD A0           243          MOV     @R0,A
 00CE 8980         244 FORE3:   ORL     P1,#80H        ;TURN CONTROL OFF
 00D0 23FF         245          MOV     A,#0FFH
 00D2 62           246          MOV     T,A
 00D3 25           247          EN      TCNTI
 00D4 45           248          STRT    CNT
 00D5 BC05         249          MOV     R4,#05H        ;LOOK FOR 5 MS FOR
 00D7 54B7         250          CALL    DELAY          ;I.D.
 00D9 35           251          DIS     TCNTI
 00DA 65           252          STOP    TCNT
 00DB D432         253          CALL    STTBL
 00DD B40E         254          CALL    DETECT         ;CHECK FOR PRESENTS
 00DF BC05         255          MOV     R4,#5
 00E1 54B7         256          CALL    DELAY
 00E3 048A         257          JMP     FORE
                   258 ;-----------------------------------------------
                   259 ;    READ IN I.D. ADDRESS SETTINGS
                   260 ;       PIN 17 SELECT LINE
                   261 ;                NO JUMPER          - LEFT LOWER
                   262 ;                JUMPER TO PIN 14   - LEFT UPPER
                   263 ;                              15   - RIGHT LOWER
                   264 ;                              16   - RIGHT UPPER
                   265 ;
                   266 ;-----------------------------------------------
                   267 CAL:
00E5 9AEF          268          ANL     P2,#0EFH
00E7 BC01          269          MOV     R4,#1
00E9 54B7          270          CALL    DELAY
00EB 09            271          IN      A,P1
00EC 531C          272          ANL     A,#1CH         ;MASK OFF ADDR BITS
00EE 77            273          RR      A
00EF 72F9          274          JB3     RIGHTU         ;IF RIGHT UPPER HANDLE
00F1 4351          275 ADDSET:  ORL     A,#51H         ;ADD 51H TO ADDRESS
00F3 B820          276          MOV     R0,#IDADD      ;STORE I.D. ADDRESS
00F5 A0            277          MOV     @R0,A
00F6 8A10          278          ORL     P2,#10H        ;TURN-OFF SELECT
00F8 83            279          RET
00F9 2306          280 RIGHTU:  MOV     A,#06H         ;SPECIAL FOR RIGHT UPPER
```

```
00FB 04F1          281          JMP     ADDSET
                   282 ;
                   283 ;-----------------------------------------------
                   284 ;          EXTERNAL INTERRUPT ROUTINE
                   285 ;-----------------------------------------------
                   286 ;
                   287 EXTINT:
00FD 15            288          DIS     I
00FE 93            289          RETR
                   290 ;
                   291
                   292 ;-----------------------------------------------
                   293 ;          DATA INPUT INTERRUPT ROUTINE
                   294 ;-----------------------------------------------
                   295 ;
0100               296          ORG     100H
                   297
0100 35            298 TIMINT:  DIS     TCNTI
0101 00            299          NOP
0102 BC01          300          MOV     R4,#1          ;RETURN WITH ONE COUNT
0104 D5            301          SEL     RB1
0105 AF            302          MOV     R7,A
0106 00            303          NOP
0107 00            304          NOP
0108 00            305          NOP
0109 B84B          306          MOV     R0,#DVALID
010B B0FF          307          MOV     @R0,#0FFH      ;SET DATA VALID = TRUE
010D BC0C          308          MOV     R4,#12         ;PREAMBLE = 12 BITS
010F 5400          309          CALL    RDWORD         ;READ PREAMBLE FRAME
0111 B94B          310          MOV     R1,#DVALID
0113 B83C          311          MOV     R0,#UARTL
0115 F0            312          MOV     A,@R0
0116 D3FF          313          XRL     A,#0FFH
0118 CE1C          314          JZ      TIMIN1         ;CHECK PREAMBLE VALIDITY
011A B100          315          MOV     @R1,#0
011C 18            316 TIMIN1:  INC     R0
011D F0            317          MOV     A,@R0
011E D3F0          318          XRL     A,#0F0H
0120 CE24          319          JZ      TIMIN2
0122 B100          320          MOV     @R1,#0
0124 BB05          321 TIMIN2:  MOV     R3,#05         ;DELAY FOR 5 BIT TIMES
0126 BA6B          322 TIM2A:   MOV     R2,#107
0128 4630          323 TIM2C:   JNT1    TIM2B
012A EA28          324          DJNZ    R2,TIM2C       ;LOOP FOR START BIT
012C EB2E          325          DJNZ    R3,TIM2A       ;OR TIME-OUT
012E 24AD          326          JMP     TIMIN7
0130 BA0A          327 TIM2B:   MOV     R2,#10
0132 EA32          328          DJNZ    R2,$
0134 BC10          329          MOV     R4,#16         ;16 BITS IN DATA FRAME
0136 5400          330          CALL    RDWORD         ;READ DATA FRAME
0138 B845          331          MOV     R0,#PARITY
013A F0            332          MOV     A,@R0
013B 5301          333          ANL     A,#01H
013D C645          334          JZ      TIMIN3
013F B84B          335          MOV     R0,#DVALID
0141 B000          336          MOV     @R0,#0
0143 24AD          337          JMP     TIMIN7
0145 B83C          338 TIMIN3:  MOV     R0,#UARTL
0147 B944          339          MOV     R1,#BINPTR+1   ;CONVERT DATA TO BINARY
0149 F0            340          MOV     A,@R0
014A 537F          341          ANL     A,#7FH
014C 97            342          CLR     C
014D E7            343          RRC     A
014E A1            344          MOV     @R1,A
014F 18            345          INC     R0
0150 C9            346          DEC     R1
0151 F0            347          MOV     A,@R0
0152 E7            348          RRC     A
0153 A1            349          MOV     @R1,A
0154 B84B          350          MOV     R0,#DVALID
0156 F0            351          MOV     A,@R0
0157 9E55          352          JNZ     TIMIN4
0159 24AD          353          JMP     TIMIN7
015B B843          354 TIMIN4:  MOV     R0,#BINPTR
```

```
015D B941        355          MOV     R1,#BCDPTR
015F 547D        356          CALL    BINBCD
0161 B841        357          MOV     R0,#BCDPTR
0163 F400        358          CALL    DSPLAY
0165 B842        359          MOV     R0,#BCDPTR+1
0167 B947        360          MOV     R1,#NEWDAT+1
0169 F0          361          MOV     A,@R0
016A D1          362          XRL     A,@R1
016B 9675        363          JNZ     TIM6A
016D C8          364          DEC     R0
016E C9          365          DEC     R1
016F F0          366          MOV     A,@R0
0170 D1          367          XRL     A,@R1
0171 9675        368          JNZ     TIM6A
0173 249D        369          JMP     TIM6D
                 370 TIM6A:
0175 B873        371          MOV     R0,#FAILB
0177 F0          372          MOV     A,@R0
0178 9691        373          JNZ     TIM6BA
                 374 TIM6B:
017A B876        375          MOV     R0,#IDFLG
017C B0FF        376          MOV     @R0,#0FFH;
017E B848        377          MOV     R0,#OLDDAT
0180 F0          378          MOV     A,@R0
0181 18          379          INC     R0
0182 40          380          ORL     A,@R0
0183 CE93        381          JZ      TIM6C
0185 B874        382          MOV     R0,#PRESST
0187 B005        383          MOV     @R0,#05
0189 D485        384          CALL    ACPTID          ;ACCEPT PREVIOUS LOW NUM
                     BER
018B B872        385          MOV     R0,#PSTATE
018D B006        386          MOV     @R0,#6          ;NEW STATE = 6
018F 2493        387          JMP     TIM6C
                 388 TIM6BA:
0191 D493        389          CALL    ACPNEW          ;ACCEPT NEW TRANS #
                 390                                  ;IF NO SENSING
                 391 TIM6C:
0193 B946        392          MOV     R1,#NEWDAT
0195 B841        393          MOV     R0,#BCDPTR
0197 F0          394          MOV     A,@R0
0198 A1          395          MOV     @R1,A
0199 18          396          INC     R0
019A 19          397          INC     R1
019B F0          398          MOV     A,@R0
019C A1          399          MOV     @R1,A
                 400 TIM6D:
019D B875        401          MOV     R0,#TRCNTR
019F B0FE        402          MOV     @R0,#TRCNT      ;RESET TRANS LOSS
01A1 B874        403          MOV     R0,#PRESST      ;COUNTER
01A3 F0          404          MOV     A,@R0
01A4 4301        405          ORL     A,#01
01A6 A0          406          MOV     @R0,A
01A7 D432        407          CALL    STTBL
01A9 B8EE        408          MOV     R0,#BLCNT
01AB B0D3        409          MOV     @R0,#BCOUNT
                 410 TIMIN7:
01AD FF          411 TIMIN8:  MOV     A,R7
01AE 93          412          RETR
                 413 ;
                 414 ;-----------------------------------------------------
                 415 ;          DATA INPUT TEST ROUTINE
                 416 ;-----------------------------------------------------
                 417 ;
                 418
0078             419 COUNT2   EQU     120
                 420
                 421 INTST:
01AF BC00        422          MOV     R4,#0
01B1 BE78        423          MOV     R6,#COUNT2
01B3 BA07        424 INTS1:   ORL     P2,#DSEL
01B5 9AFB        425          ANL     P2,#UARTCA
01B7 80          426          MOVX    A,@R0
```

```
01B8 AA          427          MOV     R2,A
01B9 37          428          CPL     A
01BA 32C6        429          JB1     INTS2          ;INPUT DATA PENDING
01BC 9AFA        430          ANL     P2,#UARTDA     ;YES, READ BYTE
01BE 80          431          MOVX    A,@R0
01BF AB          432          MOV     R3,A           ;SAVE IN R3
01C0 FA          433          MOV     A,R2
01C1 5338        434          ANL     A,#38H         ;TRANSMISSION ERROR
01C3 AA          435          MOV     R2,A
01C4 BCFF        436          MOV     R4,#0FFH       ;CHARACTER FLAG
01C6 BE01        437          MOV     R6,#1
01C8 8A07        438 INTS2:   ORL     P2,#DSEL
01CA EEB3        439          DJNZ    R6,INTS1       ;WAIT FOR TIMEOUT
01CC FC          440          MOV     A,R4           ;RETURN WITH DATA
01CD 83          441          RET                    ;FLAG IN ACC
                 442
                 443
0200             444          ORG     0200H
                 445
                 446
0200 8A20        447 RDWORD:  ORL     P2,#20H        ;SET PIN 18 HIGH
0202 B84C        448          MOV     R0,#HFBIT
0204 B000        449          MOV     @R0,#0
0206 B845        450          MOV     R0,#PARITY     ;INITIALIZE PARITY
0208 B000        451          MOV     @R0,#0
020A B83C        452          MOV     R0,#UARTL
020C B000        453          MOV     @R0,#0         ;INITIALIZE SERIAL LINK
020E 18          454          INC     R0             ;WORD
020F B000        455          MOV     @R0,#0
0211 BA0F        456          MOV     R2,#15         ;DELAY FOR 1/4 BIT TIME
0213 EA13        457          DJNZ    R2,$
0215 461D        458          JNT1    RDWD1
0217 B84B        459          MOV     R0,#DVALID
0219 B000        460          MOV     @R0,#0
021B 4447        461          JMP     RDWD4
021D 542A        462 RDWD1:   CALL    RDBIT
021F 1227        463          JB0     RDWD2          ;CHECK FOR VALID
0221 B84B        464          MOV     R0,#DVALID     ;MANCHESTER DATA BIT
0223 B000        465          MOV     @R0,#0
0225 4447        466          JMP     RDWD4
0227 E62C        467 RDWD2:   JNC     RDWD3
0229 B845        468          MOV     R0,#PARITY
022B 10          469          INC     @R0
022C B83C        470 RDWD3:   MOV     R0,#UARTL
022E F0          471          MOV     A,@R0
022F 67          472          RRC     A
0230 A0          473          MOV     @R0,A
0231 18          474          INC     R0
0232 F0          475          MOV     A,@R0
0233 67          476          RRC     A
0234 A0          477          MOV     @R0,A
0235 BA3E        478          MOV     R2,#62         ;DELAY FROM 1/2
0237 EA37        479          DJNZ    R2,$           ;BIT TIMES
0239 545D        480          CALL    RDHBIT         ;READ HALF BIT DATA
023B B84B        481          MOV     R0,#DVALID
023D F0          482          MOV     A,@R0
023E C647        483          JZ      RDWD4
0240 00          484          NOP
0241 BA47        485          MOV     R2,#71
0243 EA43        486          DJNZ    R2,$           ;DELAY ANOTHER 1/2 BIT
0245 EC1D        487          DJNZ    R4,RDWD1       ;READ REST OF DATA
0247 9ADF        488 RDWD4:   ANL     P2,#0DFH       ;SET PIN 18 LOW
0249 83          489          RET
                 490
024A B84C        491 RDBIT:   MOV     R0,#HFBIT
024C 2300        492          MOV     A,#0
024E 9ADF        493          ANL     P2,#0DFH       ;BENCHMARK FLAG
0250 97          494          CLR     C
0251 A7          495          CPL     C
0252 4655        496          JNT1    RDBIT1
0254 97          497          CLR     C
0255 F7          498 RDBIT1:  RLC     A
0256 8A20        499          ORL     P2,#20H        ;BENCHMARK FLAG
0258 A9          500          MOV     R1,A
```

```
025B E7          501             RRC     A
025A F0          502             MOV     A,@R0           ;RET WITH BIT IN CARRY
025B D9          503             XRL     A,R1            ;A = 1 FOR VALID DATA
025C 83          504             RET
                 505
                 506 RDHBIT:
025D BB4C        507             MOV     R0,#HFBIT
025F B000        508             MOV     @R0,#0
0261 9ADF        509             ANL     P2,#0DFH
0263 BA20        510             ORL     P2,#20H
0265 5E6A        511             JT1     RDHB1
0267 B001        512             MOV     @R0,#01
0269 83          513             RET
026A 00          514 RDHB1:      NOP
026B 00          515             NOP
026C 83          516             RET
                 517
                 518 BUSFRE:
026D 83          519             RET
                 520 ;
                 521
                 522 ;
                 523 ;-----------------------------------------------------
                 524 ;           TEST FOR LEADING ZERO'S FOR DISPLAY
                 525 ;-----------------------------------------------------
                 526 ;
                 527 BNKTST:
026E BA03        528             MOV     R2,#03H         ;TEST FOR LEADING
0270 B831        529             MOV     R0,#DSBUF+3     ;ZEROES
0272 F0          530 BKTST1:     MOV     A,@R0
0273 D33F        531             XRL     A,#3FH
0275 9E7C        532             JNZ     BKTST2
0277 B000        533             MOV     @R0,#00H        ;CHANGE TO "BLANK"
0279 C8          534             DEC     R0
027A EA72        535             DJNZ    R2,BKTST1
027C 83          536 BKTST2:     RET
                 537 ;
                 538 ;-----------------------------------------------------
                 539 ;           BINBCD -- CONVERTS TRANSPONDER TO BCD
                 540 ;-----------------------------------------------------
                 541
                 542 BINBCD:
027D B100        543             MOV     @R1,#0
027F 19          544             INC     R1              ;CLR BCD POINTER
0280 B100        545             MOV     @R1,#0          ;LOCATION
0282 BA10        546             MOV     R2,#16          ;16 BITS TO CONVERT
0284 18          547             INC     R0
0285 C8          548 BIN1:       DEC     R0
0286 C9          549             DEC     R1
0287 97          550             CLR     C
0288 F0          551             MOV     A,@R0
0289 F7          552             RLC     A
028A A0          553             MOV     @R0,A
028B 18          554             INC     R0
028C F0          555             MOV     A,@R0
028D F7          556             RLC     A
028E A0          557             MOV     @R0,A
028F F1          558             MOV     A,@R1
0290 71          559             ADDC    A,@R1
0291 57          560             DA      A
0292 A1          561             MOV     @R1,A
0293 19          562             INC     R1
0294 F1          563             MOV     A,@R1
0295 71          564             ADDC    A,@R1
0296 57          565             DA      A
0297 A1          566             MOV     @R1,A
0298 EA85        567             DJNZ    R2,BIN1
029A 83          568             RET
                 569
                 570
                 571 ;-----------------------------------------------------
                 572 ;                   POP ROUTINE
                 573 ;-----------------------------------------------------
                 574
```

```
                    575 POP:
02AE BA1C           576             MOV     R2,#28
02B0 B84D           577             MOV     R0,#IDBUF
02B2 B94F           578             MOV     R1,#IDBUF+2
02B4 F1             579 POP1:       MOV     A,@R1
02B5 A0             580             MOV     @R0,A           ;POP OFF 1ST NUMBER
02B6 18             581             INC     R0
02B7 19             582             INC     R1
02B8 EAB4           583             DJNZ    R2,POP1
02BA B0FF           584             MOV     @R0,#0FFH
02BC 18             585             INC     R0
02BD B0FF           586             MOV     @R0,#0FFH
02BF B86D           587             MOV     R0,#IDQUE
02C1 F0             588             MOV     A,@R0
02C2 C6C8           589             JZ      POP2
02C4 07             590             DEC     A               ;RESET QUE POINTER
02C5 C6C8           591             JZ      POP2
02C7 07             592             DEC     A
02C8 A0             593 POP2:       MOV     @R0,A
02C9 83             594             RET
                    595
                    596 ;-----------------------------------------------
                    597 ;           1 MSEC DELAY
                    598 ;  ON ENTRY R4 HOLDS NUMBER OF MSEC FOR DELAY
                    599 ;-----------------------------------------------
                    600
                    601 DELAY:
02CA 00             602             NOP
02CB 00             603             NOP
02CC BEA7           604             MOV     R6,#167         ;1 MSEC DELAY
02CE EECE           605             DJNZ    R6,$
02D0 00             606             NOP
02D1 00             607             NOP
02D2 ECCA           608             DJNZ    R4,DELAY        ;NUMBER OF MSEC
02D4 83             609             RET
                    610
                    611 ;-----------------------------------------------
                    612 ;           RSTAT-- RESET ZONE1 OR ZONE2 STATUS FLAG
                    613 ;           R4 CONTAINS BIT MASK
                    614 ;-----------------------------------------------
                    615 ;
                    616
                    617 RSTAT:
02D5 B874           618             MOV     R0,#PRESST
02D7 F0             619             MOV     A,@R0
02D8 5C             620             ANL     A,R4            ;RESET APP. BIT
02D9 A0             621             MOV     @R0,A
02DA D435           622             CALL    STTBL           ;UPDATE STATE TABLE
02DC 83             623             RET
                    624
                    625 ;-----------------------------------------------
                    626 ;           SSTAT-- SETS ZONE1 OR ZONE2 STATUS FLAGS
                    627 ;           R4 CONTAINS BIT TO BE SET
                    628 ;-----------------------------------------------
                    629 ;
                    630 SSTAT:
02DD B874           631             MOV     R0,#PRESST
02DF F0             632             MOV     A,@R0
02E0 4C             633             ORL     A,R4            ;SET APP. BIT
02E1 A0             634             MOV     @R0,A
02E2 D435           635             CALL    STTBL           ;UPDATE STATE TABLE
02E4 83             636             RET
                    637
                    638 ;-----------------------------------------------
                    639 ;           SONAR TEST
                    640 ;  TEST FOR DEFECTIVE SONAR DETECTOR
                    641 ;-----------------------------------------------
                    642 ;
                    643 STEST:
02E5 B873           644             MOV     R0,#FAILB
02E7 B0FF           645             MOV     @R0,#0FFh
02E9 9A3F           646             ANL     P2,#3FH
```

```
02D8 00          647          NOP
02D9 00          648          NOP
02DA 09          649          IN      A,P1
02DB 37          650          CPL     A
02DC 5303        651          ANL     A,#03H          ;LOOK FOR MISSING OR
02DE 96ED        652          JNZ     STEST1          ;LOCK-UP OF EITHER
02E0 8AC0        653          ORL     P2,#0C0H        ;SONAR
02E2 BC14        654          MOV     R4,#20          ;LOOK FOR ECHO UP TO
02E4 54B7        655          CALL    DELAY           ;15 FEET
02E6 09          656          IN      A,P1
02E7 9A3F        657          ANL     P2,#3FH         ;TURN OFF BOTH SONARS
02E9 5303        658          ANL     A,#03
02EB C6F1        659          JZ      STEST2          ;CHECK FOR RESPONSE FROM
                 660                                  ;BOTH SONARS
                 661 STEST1:
02ED B873        662          MOV     R0,#FAILB
02EF B0FF        663          MOV     @R0,#0FFH       ;FAILED SET FLAG
02F1 83          664 STEST2:  RET
                 665
0400             666          ORG     0400H
                 667 ;
                 668 ;-----------------------------------------------------
                 669 ;          DECODE--INPUT DECODE ROUTINE
                 670 ;                  FROM PARLOR CONTROLLER
                 671 ;-----------------------------------------------------
                 672
                 673 DECODE:
0400 BC0F        674          MOV     R4,#15
0402 FA          675 DECO1:   MOV     A,R2
0403 9E5B        676          JNZ     DECO4
0405 FB          677          MOV     A,R3
0406 37          678          CPL     A
0407 125B        679          JB0     DECO4           ;CHECK FOR ADDRESS BYTE
0409 FB          680          MOV     A,R3
040A B820        681          MOV     R0,#IDADD       ;OWN ADDRESS?
040C D0          682          XRL     A,@R0
040D 965B        683          JNZ     DECO4
040F 34AF        684          CALL    INTST           ;WAIT FOR BUS FREE
0411 BC0C        685          MOV     R4,#12          ;MESSAGE
0413 C65B        686          JZ      DECO4
0415 FA          687          MOV     A,R2
0416 9E5B        688          JNZ     DECO4
0418 FB          689          MOV     A,R3
0419 D37E        690          XRL     A,#7EH
041B C634        691          JZ      DECO0           ;BUS FREE OUTPUT ID BYTE
041D FB          692          MOV     A,R3
041E D378        693          XRL     A,#78H          ;CHECK FOR REPEAT PRO
0420 C64C        694          JZ      DECO2B          ;PC REPEAT, OUTPUT SAME
0422 845B        695          JMP     DECO4           ;VALUE ELSE ABORT
0424 B822        696 DECO0:   MOV     R0,#OUTBUF
0426 B920        697          MOV     R1,#IDADD
0428 F1          698          MOV     A,@R1
0429 A0          699          MOV     @R0,A
042A 18          700          INC     R0
042B B00E        701          MOV     @R0,#0EH
042D 18          702          INC     R0
042E B94D        703          MOV     R1,#IDBUF
0430 F1          704          MOV     A,@R1
0431 530F        705          ANL     A,#0FH
0433 E7          706          RL      A
0434 A0          707          MOV     @R0,A
0435 18          708          INC     R0
0436 F1          709          MOV     A,@R1
0437 53F0        710          ANL     A,#0F0H
0439 47          711          SWAP    A
043A E7          712          RL      A
043B A0          713          MOV     @R0,A
043C 18          714          INC     R0
043D 19          715          INC     R1
043E F1          716          MOV     A,@R1
043F 530F        717          ANL     A,#0FH
0441 E7          718          RL      A
```

```
0442 A0          719           MOV     @R0,A
0443 18          720           INC     R0
0444 F1          721           MOV     A,@R1
0445 53F0        722           ANL     A,#0F0H
0447 47          723           SWAP    A
0448 E7          724           RL      A
0449 A0          725           MOV     @R0,A
044A 9467        726 DEC02:    CALL    XFER            ;TRANSFER OUTPUT BUFFER
                 727                                   ;TO OLDBUFFER
044C BA0E        728 DEC025:   MOV     R2,#E
044E B822        729           MOV     R0,#OUTBUF      ;TRANSMIT ID DATA
0450 F430        730           CALL    XMIT
0452 34AF        731           CALL    INTST           ;CHECK FOR REPEAT
0454 BC01        732           MOV     R4,#1           ;REQUEST FROM PC
0456 9602        733           JNZ     DEC01
0458 549B        734           CALL    POP             ;INFO RECEIVED,
045A 83          735           RET                     ;    POP STACK
045B 5467        736 DEC04:    CALL    DELAY           ;POP ID OFF STACK
045D 83          737 DEC05:    RET
                 738
                 739
045E B84A        740 TURNON:   MOV     R0,#IDCNTL
0460 B0FF        741           MOV     @R0,#ON
0462 B84A        742 TNOFF:    MOV     R0,#IDCNTL
0464 B000        743           MOV     @R0,#OFF
0466 83          744           RET
                 745
                 746 XFER:
0467 B822        747           MOV     R0,#OUTBUF
0469 B928        748           MOV     R1,#OLDBUF
046B BA06        749           MOV     R2,#6
046D F0          750 XFER1:    MOV     A,@R0
046E A1          751           MOV     @R1,A
046F EA6D        752           DJNZ    R2,XFER1
0471 83          753           RET
                 754
                 755 ;-----------------------------------------------
                 756 ;         DATOUT--DATA OUTPUT ROUTINE
                 757 ;-----------------------------------------------
                 758
00A5             759 COUNT     EQU     165             ;BUS QUIET BASE TIME
00FA             760 COUNT1    EQU     250             ;3 MSEC TIMOUT FOR XMIT
                 761
                 762 DATOUT:
0472 14E5        763           CALL    CAL
0474 B820        764           MOV     R0,#IDADD
0476 F0          765           MOV     A,@R0
0477 77          766           RR      A
0478 5303        767           ANL     A,#03
047A AA          768           MOV     R2,A
047B 1A          769           INC     R2
047C 23A5        770           MOV     A,#COUNT
047E 0305        771 DAT1:     ADD     A,#05
0480 EA7E        772           DJNZ    R2,DAT1
0482 AB          773           MOV     R3,A
0483 BCFA        774           MOV     R4,#COUNT1
0485 EC89        775 DAT2:     DJNZ    R4,DAT2A
0487 84A1        776           JMP     DAT5
0489 FB          777 DAT2A:    MOV     A,R3
048A AA          778           MOV     R2,A
048B 8E85        779 DAT3:     JNI     DAT2
048D 00          780           NOP
048E 00          781           NOP
048F 00          782           NOP
0490 00          783           NOP
0491 EA8E        784           DJNZ    R2,DAT3
0493 B820        785           MOV     R0,#IDADD
0495 BA01        786           MOV     R2,#1
0497 F430        787           CALL    XMIT
0499 34AF        788 DAT4:     CALL    INTST
049B C6A1        789           JZ      DAT5
049D 9400        790           CALL    DECODE
049F 84A5        791           JMP     DAT6
04A1 BC0E        792 DAT5:     MOV     R4,#14
```

```
04A3 5487          793             CALL    DELAY
04A5 83            794 DAT6:       RET
                   795 ;
                   796 ;-----------------------------------------------------
                   797 ;           OUTPUT DATA TEST
                   798 ;-----------------------------------------------------
                   799
                   800 OUTST:
04A6 B84D          801             MOV     R0,#IDBUF
04A8 F0            802             MOV     A,@R0
14A9 37            803             CPL     A
14AA C6B0          804             JZ      OUTS1
14AC 9472          805             CALL    DATOUT
14AE 84B8          806             JMP     OUTS3
14B0 B8ED          807 OUTS1:      MOV     R0,#IDQUE
14B2 B000          808             MOV     @R0,#0
14B4 BC12          809 OUTS2:      MOV     R4,#18          ;18 MSEC DELAY
14B6 54B7          810             CALL    DELAY
14B8 83            811 OUTS3:      RET
                   812
                   813
                   814 ;*****************************************************
                   815 ;           GATE TEST ROUTINE
                   816 ; CALLED FROM FORE GROUND
                   817 ;
                   818 ;*****************************************************
                   819
04B9 09            820 GTEST:      IN      A,P1            ;TEST IF GATE SWITCH
04BA 37            821             CPL     A
04BB B2D4          822             JB5     GTEST1          ;CLOSED SET TO BYPASS
04BD BC01          823             MOV     R4,#01          ;DELAY 1 MSEC
04BF 54B7          824             CALL    DELAY
04C1 09            825             IN      A,P1            ;RE-TEST GATE SWITCH
04C2 37            826             CPL     A
04C3 B2D4          827             JB5     GTEST1
04C5 99BF          828             ANL     P1,#0BFH        ;SET SYNC LINE HIGH
04C7 94AE          829             CALL    OUTST           ;CK FOR DATA OUT
04C9 B871          830             MOV     R0,#DSTAT       ;TURN-OFF GATE LIGHT
04CB F0            831             MOV     A,@R0
04CC 5304          832             ANL     A,#04H
04CE A0            833             MOV     @R0,A
04CF B488          834             CALL    TEST1           ;UPDATE PANEL LIGHTS
04D1 BC32          835             MOV     R4,#50          ;SET DELAY FOR 50 MSEC
04D3 83            836             RET
04D4 BC00          837 GTEST1:     MOV     R4,#0
04D6 B873          838             MOV     R0,#FAILB       ;CHECK IF SONAR LIGHTS
04D8 F0            839             MOV     A,@R0           ;SHOULD BE LIT
04D9 C6DD          840             JZ      GTEST2
04DB BCC0          841             MOV     R4,#0C0H
04DD B871          842 GTEST2:     MOV     R0,#DSTAT       ;TURN-ON GATE LIGHT
04DF F0            843             MOV     A,@R0
04E0 4320          844             ORL     A,#20H
04E2 4C            845             ORL     A,R4
04E3 A0            846             MOV     @R0,A
04E4 B488          847             CALL    TEST1
04E6 BC00          848             MOV     R4,#0           ;SET TO TURN ON LOOP
04E8 83            849             RET
                   850
                   851
                   852 ;-----------------------------------------------------
                   853 ;           BLANK DISPLAY AFTER 400 MSEC
                   854 ;           AND TEST FOR WORKING SONARS
                   855 ;-----------------------------------------------------
                   856 ;
0500               857             ORG     500H
                   858 BLKDIS:
0500 54D2          859             CALL    STEST           ;TEST FOR WORKING SONAR
0502 B82E          860             MOV     R0,#DSBUF       ;CLEAR DISPLAY BUFFER
0504 BD05          861             MOV     R5,#05
0506 B000          862 LPBLK:      MOV     @R0,#0H
0508 18            863             INC     R0
```

```
0509 ED06          864             DJNZ    R5,LPBLK
050B F41C          865 BKDISE:     CALL    DSWRE           ;OUTPUT TO DISPLAY
050D 83            866             RET
                   867
                   868
                   869 ;-----------------------------------------------
                   870 ;  DETECTION ROUTINE FOR COW PRESENTS
                   871 ; S.U.  PINS 20 19    TURN ON SIGNALS PORT 2,BITS 7 6
                   872 ;       PINS 13 12    ECHO SIGNALS    PORT 1,BITS 1 0
                   873 ;-----------------------------------------------
                   874 ;
                   875
                   876
050E B877          877 DETECT:     MOV     R0,#DTIME
0510 10            878             INC     @R0
0511 F0            879             MOV     A,@R0
0512 C616          880             JZ      DETCT1
0514 A488          881             JMP     TEST1
                   882 DETCT1:
0516 B0FE          883             MOV     @R0,#DCOUNT
0518 9A3F          884             ANL     P2,#3FH         ;RESET BOTH XMIT
051A BC01          885             MOV     R4,#1           ;CONTROLS
051C 54B7          886             CALL    DELAY           ;DELAY FOR 1 MSEC
051E 8A40          887             ORL     P2,#040H        ;TURN-ON ENTRANCE
0520 BC05          888             MOV     R4,#5           ;SONAR
0522 54B7          889             CALL    DELAY
0524 09            890             IN      A,P1
0525 323D          891             JB1     NOPRS1
                   892
0527 B878          893             MOV     R0,#ONDLY1
0529 10            894             INC     @R0
052A F0            895             MOV     A,@R0
052B 9651          896             JNZ     RSEN2           ;CHECK FOR ON DELAY
052D B87A          897             MOV     R0,#OFDLY1
052F B0FE          898             MOV     @R0,#OFCNT      ;RESET OFF COUNTER
0531 B871          899             MOV     R0,#DSTAT
0533 F0            900             MOV     A,@R0
0534 4380          901             ORL     A,#80H          ;PRESENTS DETECTED
0536 A0            902             MOV     @R0,A           ;TURN-ON ENTRANCE
0537 BC02          903             MOV     R4,#02          ;LIGHT
0539 54CA          904             CALL    SSTAT           ;UPDATE STATE TABLE
053B A451          905             JMP     RSEN2
                   906
                   907 NOPRS1:
                   908
053D B87A          909             MOV     R0,#OFDLY1
053F 10            910             INC     @R0
0540 F0            911             MOV     A,@R0
0541 9651          912             JNZ     RSEN2
0543 B878          913             MOV     R0,#ONDLY1
0545 B0FE          914             MOV     @R0,#ONCNT
0547 B871          915             MOV     R0,#DSTAT
0549 F0            916             MOV     A,@R0
054A 537F          917             ANL     A,#7FH          ;TURN OFF LED
054C A0            918             MOV     @R0,A
054D BCFD          919             MOV     R4,#0FDH
054F 54C2          920             CALL    RSTAT           ;RESET ENTRANCE STATUS
                   921
                   922 RSEN2:
0551 BC01          923             MOV     R4,#1
0553 54B7          924             CALL    DELAY           ;PAUSE 1 MSEC
0555 8A80          925             ORL     P2,#80H         ;TURN ON EXIT SONAR
0557 BC05          926             MOV     R4,#5
0559 54B7          927             CALL    DELAY           ;WAIT FOR ECHO
055B 09            928             IN      A,P1
055C 1274          929             JB0     NOPRS2
                   930
055E B879          931             MOV     R0,#ONDLY2
0560 10            932             INC     @R0
0561 F0            933             MOV     A,@R0
0562 9688          934             JNZ     TEST1
0564 B87B          935             MOV     R0,#OFDLY2
```

```
0566 B0FE        936          MOV     @R0,#0FCNT
0568 B871        937          MOV     R0,#DSTAT
056A F0          938          MOV     A,@R0
056B 4340        939          ORL     A,#40H          ;SET LED #3 ON
056D A0          940          MOV     @R0,A
056E BC04        941          MOV     R4,#04H
0570 54CA        942          CALL    SSTAT           ;UPDATE STATE TABLE
0572 A488        943          JMP     TEST1
                 944
                 945 NOPRS3:
0574 B87B        946          MOV     R0,#0FDLY3
0576 10          947          INC     @R0
0577 F0          948          MOV     A,@R0
0578 9688        949          JNZ     TEST1
057A B879        950          MOV     R0,#ONDLY3
057C B0FE        951          MOV     @R0,#ONCNT
057E B871        952          MOV     R0,#DSTAT
0580 F0          953          MOV     A,@R0
0581 53BF        954          ANL     A,#0BFH         ;TURN LED #3 OFF
0583 A0          955          MOV     @R0,A
0584 BCFB        956          MOV     R4,#0FBH
0586 54C2        957          CALL    RSTAT           ;UPDATE STATE TABLE
                 958
                 959 TEST1:
0588 B871        960          MOV     R0,#DSTAT
058A F0          961          MOV     A,@R0
058B B832        962          MOV     R0,#DSBUF+4
058D A0          963          MOV     @R0,A
058E 18          964          INC     R0
058F A0          965          MOV     @R0,A
0590 F41C        966          CALL    DSWR2           ;UPDATE PANEL LEDS
0592 83          967          RET
                 968
                 969 IDTST:
0593 B87D        970          MOV     R0,#IDLEC3
0595 10          971          INC     @R0
0596 F0          972          MOV     A,@R0
0597 96AA        973          JNZ     IDTS2           ; CHECKS IF COMMAND
0599 B0D3        974          MOV     @R0,#CNT3       ; STANDING IN LOOP, IF
059B B87C        975          MOV     R0,#IDLECT      ; SO, THEN CLEAR OUT NEW
059D 10          976          INC     @R0             ; DATA AND SEND TO FRONT
                   R
059E F0          977          MOV     A,@R0           ; CONTROLLER
059F 96AA        978          JNZ     IDTS2
05A1 B0FD        979          MOV     @R0,#CNT1
05A3 B84E        980          MOV     R0,#NEWDAT
05A5 B099        981          MOV     @R0,#099H
05A7 18          982          INC     R0
05A8 B099        983          MOV     @R0,#099H
05AA 83          984 IDTS2:   RET
                 985
                 986 ;
                 987 ;
                 988 ;-----------------------------------------------
                 989 ;                INPUT DATA CONVERSION ROUTINE
                 990 ;-----------------------------------------------
                 991 ;
0600             992          ORG     600H
                 993
                 994 DATCON:
0600 B837        995          MOV     R0,#INBUF+3
0602 F0          996          MOV     A,@R0
0603 77          997          RR      A
0604 530F        998          ANL     A,#0FH
0606 AB          999          MOV     R3,A
0607 18         1000          INC     R0
0608 F0         1001          MOV     A,@R0
0609 E7         1002          RL      A
060A 53F0       1003          ANL     A,#0F0H
060C DB         1004          XRL     A,R3
060D A1         1005          MOV     @R1,A
060E 19         1006          INC     R1
060F F0         1007          MOV     A,@R0
0610 E7         1008          RL      A
```

```
0611 530C       1005            ANL     A,#0CH
0613 47         1010            SWAP    A
0614 AB         1011            MOV     R3,A
0615 18         1012            INC     R0
0616 F0         1013            MOV     A,@R0
0617 77         1014            RR      A
0618 533F       1015            ANL     A,#3FH
061A DB         1016            XRL     A,R3
061B A1         1017            MOV     @R1,A
061C 83         1018            RET
                1019 ;
                1020 ;-----------------------------------------------
                1021 ;       PUSH-- STORES TRANSPONDERS FIFO
                1022 ;
                1023 ;  R4-- TRANSPONDER # MSB
                1024 ;  R3-- TRANSPONDER # LSB
                1025 ;-----------------------------------------------
                1026
061D B86D       1027 PUSH:
061F F0         1028            MOV     R0,#IDQUE
0620 034D       1029            MOV     A,@R0
0622 A9         1030            ADD     A,#IDBUF
0623 FB         1031            MOV     R1,A
0624 A1         1032            MOV     A,R3            ;TRANS # LSB
0625 19         1033            MOV     @R1,A
0626 FC         1034            INC     R1
0627 A1         1035            MOV     A,R4            ;TRANS # MSB
0628 10         1036            MOV     @R1,A
0629 10         1037            INC     @R0
062A F0         1038            INC     @R0             ;NEXT AVAILABLE LOCA..
062B 03E0       1039            MOV     A,@R0
062D E631       1040            ADD     A,#-32          ;OVERFLOW?
062F B000       1041            JNC     PUSH1
0631 83         1042            MOV     @R0,#0
                1043 PUSH1:     RET
                1044
                1045 ;-----------------------------------------------
                1046 ;                STATE TABLE ROUTINE
                1047 ;-----------------------------------------------
                1048
                1049 STTBL:
0632 B873       1050            MOV     R0,#FAILB
0634 F0         1051            MOV     A,@R0
0635 9E6C       1052            JNZ     STTBL1
0637 B873       1053            MOV     R0,#PSTATE
0639 F0         1054            MOV     A,@R0
063A AC         1055            MOV     R4,A
063B 03F9       1056            ADD     A,#-7
063D C643       1057            JZ      STTB0
063F 07         1058            DEC     A               ;IF STATE 8 OR 9
0640 07         1059            DEC     A
0641 9E52       1060            JNZ     STTB1
0643 B87E       1061 STTB0:     MOV     R0,#IDFLG
0645 F0         1062            MOV     A,@R0
0646 CE52       1063            JZ      STTB1
0648 B84E       1064            MOV     R0,#NEWDAT
064A B948       1065            MOV     R1,#OLDDAT
064C F0         1066            MOV     A,@R0
064D A1         1067            MOV     @R1,A
064E 18         1068            INC     R0
064F 19         1069            INC     R1
0650 F0         1070            MOV     A,@R0
0651 A1         1071            MOV     @R1,A
0652 FC         1072 STTB1:     MOV     A,R4
0653 E7         1073            RL      A
0654 E7         1074            RL      A
0655 E7         1075            RL      A               ;PREVIOUS STATE * 8
0656 B974       1076            MOV     R1,#PRESST
0658 61         1077            ADD     A,@R1           ;NEW STATE LOCATION =
                1078                                    ;(PREV STATE*8 + STATUS
                1079 ;
0659 E3         1079            MOVP3   A,@A
065A AB         1080            MOV     R3,A
```

```
065B B872          1081          MOV     R0,#PSTATE
065D 03A6          1082          ADD     A,#-90
065F C66D          1083          JZ      ST90
0661 07            1084          DEC     A
0662 C671          1085          JZ      ST91
0664 07            1086          DEC     A
0665 C679          1087          JZ      ST92
0667 07            1088          DEC     A
0668 C67D          1089          JZ      ST93
066A F8            1090          MOV     A,R0
066B A0            1091          MOV     @R0,A          ;STORE NEW STATUS
066C 83            1092 STTBL1:  RET
                   1093
                   1094 ST90:
066D B001          1095          MOV     @R0,#1         ;NEW STATE = 1
066F C481          1096          JMP     ACCID          ;ACCEPT ID
                   1097
                   1098 ST91:
0671 B002          1099          MOV     @R0,#2         ;NEW STATE = 2
0673 B87E          1100          MOV     R0,#IDFLG
0675 B000          1101          MOV     @R0,#0
0677 C481          1102          JMP     ACCID          ;ACCEPT ID
                   1103
                   1104 ST92:
0679 B003          1105          MOV     @R0,#3         ;STATE = 3
067B C481          1106          JMP     ACCID
                   1107
                   1108 ST93:
067D B001          1109          MOV     @R0,#1
067F C4AD          1110          JMP     NULCOW
                   1111
                   1112 ACCID:
0681 B87E          1113          MOV     R0,#IDFLG
0683 B000          1114          MOV     @R0,#0
                   1115 ACPTID:
0685 B848          1116          MOV     R0,#OLDDAT
0687 F0            1117 ACPTD1:  MOV     A,@R0
0688 AB            1118          MOV     R3,A           ;TRANS # LSB
0689 B000          1119          MOV     @R0,#0
068B 18            1120          INC     R0
068C F0            1121          MOV     A,@R0
068D AC            1122          MOV     R4,A           ;TRANS # MSB
068E B000          1123          MOV     @R0,#0
0690 D41D          1124          CALL    PUSH           ;OUTPUT TRANSP NUMBER
0692 83            1125          RET                    ;TO PARLOR CONTROLLER
                   1126
                   1127 ACPNEW:
0693 B841          1128          MOV     R0,#BCDPTR     ;SENSING FAILURE
0695 F0            1129          MOV     A,@R0          ;SO ACCEPT I.D.
0696 AB            1130          MOV     R3,A
0697 18            1131          INC     R0
0698 F0            1132          MOV     A,@R0
0699 AC            1133          MOV     R4,A
069A D41D          1134          CALL    PUSH
069C 83            1135          RET
                   1136
                   1137 REMCOW:
069D B848          1138          MOV     R0,#OLDDAT
069F B0AA          1139          MOV     @R0,#0AAh
06A1 18            1140          INC     R0
06A2 B0AA          1141          MOV     @R0,#0AAH
06A4 B84E          1142          MOV     R0,#NEWDAT
06A6 B000          1143          MOV     @R0,#0
06A8 18            1144          INC     R0
06A9 B000          1145          MOV     @R0,#0
06AB C481          1146          JMP     ACCID
                   1147
                   1148
                   1149 NULCOW:
06AD B876          1150          MOV     R0,#IDFLG
06AF F0            1151          MOV     A,@R0
06B0 96B9          1152          JNZ     NULCW1
06B2 B848          1153          MOV     R0,#OLDDAT     ;COW WITHOUT TRANSPONDER
```

```
0684 B000          1154            MOV     @R0,#0
0686 18            1155            INC     R0
0687 B000          1156            MOV     @R0,#0
0689 C481          1157 NULCW1:    JMP     ACCID           ;SEND COW NUMBER &
                   1158                                    ;FOR BLANK DISPLAY
                   1159 ACPSEN:
0688 83            1160            RET
                   1161
                   1162 ;-----------------------------------------------
                   1163 ;           STATE TABLE
                   1164 ; AS DEFINED IN STATE FLOW-CHART
                   1165 ;-----------------------------------------------
                   1166
0300               1167            ORG     0300H
                   1168
0300 01            1169            DB      1               ;PREVIOUS STATE = 0
0301 01            1170            DB      1
0302 01            1171            DB      1
0303 01            1172            DB      1
0304 01            1173            DB      1
0305 01            1174            DB      1
0306 01            1175            DB      1
0307 01            1176            DB      1
                   1177
0308 01            1178            DB      1               ;PREV. STATE = 1
0309 02            1179            DB      2
030A 03            1180            DB      3
030B 01            1181            DB      1
030C 04            1182            DB      4
030D 01            1183            DB      1
030E 01            1184            DB      1
030F 01            1185            DB      1
                   1186
0310 01            1187            DB      1               ;PREV. STATE = 2
0311 02            1188            DB      2
0312 01            1189            DB      1
0313 05            1190            DB      5
0314 01            1191            DB      1
0315 06            1192            DB      6
0316 01            1193            DB      1
0317 01            1194            DB      1
                   1195
0318 01            1196            DB      1               ;PREV. STATE = 3
0319 01            1197            DB      1
031A 03            1198            DB      3
031B 05            1199            DB      5
031C 01            1200            DB      1
031D 01            1201            DB      1
031E 07            1202            DB      7
031F 01            1203            DB      1
                   1204
0320 01            1205            DB      1               ;PREV. STATE = 4
0321 01            1206            DB      1
0322 01            1207            DB      1
0323 01            1208            DB      1
0324 04            1209            DB      4
0325 06            1210            DB      6
0326 0C            1211            DB      12
0327 01            1212            DB      1
                   1213
0328 01            1214            DB      1               ;PREV. STATE = 5
0329 02            1215            DB      2
032A 17            1216            DB      23
032B 05            1217            DB      5
032C 01            1218            DB      1
032D 01            1219            DB      1
032E 01            1220            DB      1
032F 08            1221            DB      8
                   1222
0330 01            1223            DB      1               ;PREV. STATE = 6
```

```
0331 0E          1224          DB      E
0332 01          1225          DB      1
0333 01          1226          DB      1
0334 04          1227          DB      4
0335 0E          1228          DB      E
0336 01          1229          DB      1
0337 0B          1230          DB      B
                 1231
0338 01          1232          DB      1          ;PREV. STATE = 7
0339 01          1233          DB      1
033A 03          1234          DB      3
033B 01          1235          DB      1
033C 0F          1236          DB      15
033D 01          1237          DB      1
033E 07          1238          DB      7
033F 08          1239          DB      8
                 1240
0340 01          1241          DB      1          ;PREV. STATE = 8
0341 01          1242          DB      1
0342 01          1243          DB      1
0343 05          1244          DB      5
0344 01          1245          DB      1
0345 06          1246          DB      6
0346 09          1247          DB      9
0347 08          1248          DB      8
                 1249
0348 01          1250          DB      1          ;PREV. STATE = 9
0349 01          1251          DB      1
034A 5C          1252          DB      92
034B 01          1253          DB      1
034C 11          1254          DB      17
034D 01          1255          DB      1
034E 09          1256          DB      9
034F 08          1257          DB      8
                 1258
0350 01          1259          DB      1          ;PREV. STATE = 10
0351 01          1260          DB      1
0352 01          1261          DB      1
0353 01          1262          DB      1
0354 01          1263          DB      1
0355 01          1264          DB      1
0356 01          1265          DB      1
0357 01          1266          DB      1
                 1267
0358 01          1268          DB      1          ;PREV. STATE = 11
0359 01          1269          DB      1
035A 01          1270          DB      1
035B 01          1271          DB      1
035C 01          1272          DB      1
035D 01          1273          DB      1
035E 01          1274          DB      1
035F 01          1275          DB      1
                 1276
0360 01          1277          DB      1          ;PREV. STATE = 12
0361 01          1278          DB      1
0362 1E          1279          DB      30
0363 01          1280          DB      1
0364 04          1281          DB      4
0365 01          1282          DB      1
0366 0C          1283          DB      12
0367 19          1284          DB      25
                 1285
0368 01          1286          DB      1          ;PREV. STATE= 13
0369 01          1287          DB      1
036A 01          1288          DB      1
036B 01          1289          DB      1
036C 01          1290          DB      1
036D 01          1291          DB      1
036E 01          1292          DB      1
036F 01          1293          DB      1
                 1294
```

```
0370 01          1295          DB      1
0371 01          1296          DB      1          ;PREV. STATE = 14
0372 01          1297          DB      1
0373 01          1298          DB      1
0374 01          1299          DB      1
0375 01          1300          DB      1
0376 01          1301          DB      1
0377 01          1302          DB      1
                 1303
0378 5D          1304          DB      93         ;PREV. STATE = 15
0379 01          1305          DB      1
037A 01          1306          DB      1
037B 01          1307          DB      1
037C 0F          1308          DB      15
037D 06          1309          DB      6
037E 07          1310          DB      7
037F 01          1311          DB      1
                 1312
0380 01          1313          DB      1          ;PREV. STATE = 16
0381 01          1314          DB      1
0382 01          1315          DB      1
0383 01          1316          DB      1
0384 01          1317          DB      1
LOC  OBJ         LINE          SOURCE STATEMENT

0385 01          1318          DB      1
0386 01          1319          DB      1
0387 01          1320          DB      1
                 1321
0388 5A          1322          DB      90         ;PREV. STATE = 17
0389 01          1323          DB      1
038A 01          1324          DB      1
038B 01          1325          DB      1
038C 11          1326          DB      17
038D 06          1327          DB      6
038E 09          1328          DB      9
038F 01          1329          DB      1
                 1330
0390 01          1331          DB      1          ;PREV. STATE = 18
0391 01          1332          DB      1
0392 01          1333          DB      1
0393 01          1334          DB      1
0394 01          1335          DB      1
0395 01          1336          DB      1
0396 01          1337          DB      1
0397 01          1338          DB      1
                 1339
0398 01          1340          DB      1          ;PREV. STATE = 19
0399 01          1341          DB      1
039A 01          1342          DB      1
039B 01          1343          DB      1
039C 01          1344          DB      1
039D 01          1345          DB      1
039E 01          1346          DB      1
039F 01          1347          DB      1
                 1348
03A0 01          1349          DB      1          ;PREV. STATE = 20
03A1 01          1350          DB      1
03A2 01          1351          DB      1
03A3 01          1352          DB      1
03A4 01          1353          DB      1
03A5 01          1354          DB      1
03A6 01          1355          DB      1
03A7 01          1356          DB      1
                 1357
03A8 01          1358          DB      1          ;PREV. STATE = 21
03A9 01          1359          DB      1
03AA 01          1360          DB      1
03AB 01          1361          DB      1
03AC 01          1362          DB      1
03AD 01          1363          DB      1
03AE 01          1364          DB      1
```

```
LOC  OBJ          LINE          SOURCE STATEMENT

03AF 01           1365          DB      1
                  1366
03B0 01           1367          DB      1               ;PREV. STATE = 22
03B1 01           1368          DB      1
03B2 01           1369          DB      1
03B3 01           1370          DB      1
03B4 01           1371          DB      1
03B5 01           1372          DB      1
03B6 01           1373          DB      1
03B7 01           1374          DB      1
                  1375
03B8 01           1376          DB      1               ;PREV. STATE = 23
03B9 01           1377          DB      1
03BA 17           1378          DB      23
03BB 05           1379          DB      5
03BC 01           1380          DB      1
03BD 01           1381          DB      1
03BE 09           1382          DB      9
03BF 01           1383          DB      1
                  1384
03C0 01           1385          DB      1               ;PREV. STATE = 24
03C1 01           1386          DB      1
03C2 01           1387          DB      1
03C3 01           1388          DB      1
03C4 01           1389          DB      1
03C5 01           1390          DB      1
03C6 01           1391          DB      1
03C7 01           1392          DB      1
                  1393
03C8 01           1394          DB      1               ;PREV. STATE = 25
03C9 01           1395          DB      1
03CA 01           1396          DB      1
03CB 1A           1397          DB      26
03CC 01           1398          DB      1
03CD 06           1399          DB      6
03CE 0C           1400          DB      12
03CF 19           1401          DB      25
                  1402
03D0 01           1403          DB      1               ;PREV. STATE = 26
03D1 01           1404          DB      1
03D2 03           1405          DB      3
03D3 1A           1406          DB      26
03D4 01           1407          DB      1
03D5 01           1408          DB      1
03D6 01           1409          DB      1
03D7 19           1410          DB      25
                  1411

LOC  OBJ          LINE          SOURCE STATEMENT

03D8 01           1412          DB      1               ;PREV. STATE = 27
03D9 01           1413          DB      1
03DA 01           1414          DB      1
03DB 01           1415          DB      1
03DC 01           1416          DB      1
03DD 01           1417          DB      1
03DE 01           1418          DB      1
03DF 01           1419          DB      1
                  1420
03E0 01           1421          DB      1               ;PREV. STATE = 28
03E1 01           1422          DB      1
03E2 01           1423          DB      1
03E3 01           1424          DB      1
03E4 01           1425          DB      1
03E5 01           1426          DB      1
03E6 01           1427          DB      1
03E7 01           1428          DB      1
                  1429
03E8 01           1430          DB      1               ;PREV. STATE = 29
03E9 01           1431          DB      1
03EA 01           1432          DB      1
03EB 01           1433          DB      1
03EC 01           1434          DB      1
```

```
03ED 01          1435          DB      1
03EE 01          1436          DB      1
03EF 01          1437          DB      1
                 1438
03F0 01          1439          DB      1          ;PREV. STATE = 30
03F1 01          1440          DB      1
03F2 1E          1441          DB      30
03F3 03          1442          DB      3
03F4 01          1443          DB      1
03F5 01          1444          DB      1
03F6 0C          1445          DB      12
03F7 01          1446          DB      1
                 1447
03F8 01          1448          DB      1          ;PREV. STATE = 31
03F9 01          1449          DB      1
03FA 01          1450          DB      1
03FB 01          1451          DB      1
03FC 01          1452          DB      1
03FD 01          1453          DB      1
03FE 01          1454          DB      1
03FF 01          1455          DB      1
                 1456
                 1457
                 1458 ;-----------------------------------------------
                 1459 ;     DSPLAY--DISPLAY MANAGER ROUTINE
                 1460 ;-----------------------------------------------
                 1461 ;
                 1462 ;
0700             1463          ORG     0700H
                 1464
                 1465 DSPLAY:
0700 BA07        1466          ORL     P2,#DSEL
0702 BA02        1467          MOV     R2,#02
0704 B93E        1468          MOV     R1,#DSBUF
0706 F0          1469 DSPL1:   MOV     A,@R0
0707 530F        1470          ANL     A,#0FH
0709 03E0        1471          ADD     A,#0E0H;
070B A3          1472          MOVP    A,@A
070C A1          1473          MOV     @R1,A
070D 19          1474          INC     R1
070E F0          1475          MOV     A,@R0
070F 53F0        1476          ANL     A,#0F0H
0711 47          1477          SWAP    A
0712 03E0        1478          ADD     A,#0E0H
0714 A3          1479          MOVP    A,@A
0715 A1          1480          MOV     @R1,A
0716 18          1481          INC     R0
0717 19          1482          INC     R1
0718 EA06        1483          DJNZ    R2,DSPL1
071A 546E        1484          CALL    BNKTST          ;TEST FOR LEADING ZERO
071C B83E        1485 DSWR2:   MOV     R0,#DSBUF
071E F0          1486          MOV     A,@R0
071F BA05        1487          MOV     R2,#05
0721 9AFD        1488          ANL     P2,#KEYCA
0723 8330        1489          MOV     A,#DSCMD
0725 90          1490          MOVX    @R0,A
0726 9AFC        1491          ANL     P2,#KEYDA
0728 F0          1492 DSWR1:   MOV     A,@R0
0729 90          1493          MOVX    @R0,A
072A 18          1494          INC     R0
072B EA28        1495          DJNZ    R2,DSWR1
072D BA07        1496          ORL     P2,#DSEL
072F 83          1497          RET
                 1498
                 1499 ;-----------------------------------------------
                 1500 ;                XMIT--TRANSMIT ROUTINE
                 1501 ;-----------------------------------------------
                 1502 XMIT:
0730 C8          1503          DEC     R0
0731 1E          1504 TRAN1:   INC     R0
0732 BA07        1505          ORL     P2,#DSEL
```

```
LOC  OBJ          LINE     SOURCE STATEMENT

0734 9AFE         1506             ANL     P2,#UARTCA
073E 81           1507 TRAN2:      MOVX    A,@R1           ;READ STATUS
0737 37           1508             CPL     A
0738 1E3E         1509             JB0     TRANE           ;OUTPUT READY?
073A 2311         1510             MOV     A,#11H          ;DISABLE RECEIVER
073C 91           1511             MOVX    @R1,A
073D 81           1512 TRAN4:      MOVX    A,@R1
073E 37           1513             CPL     A
073F 123D         1514             JB0     TRAN4
0741 9AFA         1515             ANL     P2,#UARTDA
0743 F0           1516             MOV     A,@R0
0744 91           1517             MOVX    @R1,A           ;WRITE BYTE TO UART
0745 81           1518             MOVX    A,@R1           ;RD DATA(= ZERO RXREADY)
0746 EA31         1519             DJNZ    R2,TRAN1        ;NEXT BYTE
0748 BA01         1520             ORL     P2,#01          ;WAIT FOR TX RDY
074A 81           1521 TRAN3:      MOVX    A,@R1           ;WAIT FOR TX EMPTY
074B 37           1522             CPL     A
074C 524A         1523             JB2     TRAN3
074E 2315         1524             MOV     A,#15H
0750 91           1525             MOVX    @R1,A           ;ENABLE RECEIVER
0751 BA07         1526             ORL     P2,#DSEL
0753 83           1527             RET
                  1528 ;
                  1529 REPEAT:
0754 BBEE         1530             MOV     R0,#OUTBUF
0756 BA0E         1531             MOV     R2,#0EH
0758 F430         1532             CALL    XMIT
075A B934         1533             MOV     R1,#INPTR
075C B100         1534             MOV     @R1,#00H
075E 83           1535             RET
                  1536 ;
                  1537 ;-----------------------------------------------------
                  1538 ;       RECEPTION ACKNOWLEDGE ROUTINE
                  1539 ;-----------------------------------------------------
                  1540 ;
                  1541 ACKN:
075F B93C         1542             MOV     R1,#IDADD
0761 F1           1543             MOV     A,@R1           ;LOAD ADDRESS
0762 A0           1544             MOV     @R0,A
0763 BA03         1545             MOV     R2,#03          ;TRANS ACKN
0765 E430         1546             JMP     XMIT
                  1547
                  1548 ;-----------------------------------------------------
                  1549 ;                   DISPLAY TABLE
                  1550 ;-----------------------------------------------------
                  1551 ;
07E0              1552             ORG     07E0H           ;START OF TABLE
07E0 3F           1553             DB      3FH             ;"0"
07E1 06           1554             DB      06H             ;"1"
07E2 5B           1555             DB      5BH             ;"2"
07E3 4F           1556             DB      4FH             ;"3"
07E4 66           1557             DB      66H             ;"4"
07E5 6D           1558             DB      6DH             ;"5"
07E6 7C           1559             DB      7CH             ;"6"
07E7 07           1560             DB      07H             ;"7"
07E8 7F           1561             DB      7FH             ;"8"
07E9 6F           1562             DB      6FH             ;"9"
07EA 00           1563             DB      00H             ;"BLANK"
07EB 40           1564             DB      40H             ;"-"
07EC 61           1565             DB      61H             ;"C"
07ED 79           1566             DB      79H             ;"E
07EE 50           1567             DB      50H             ;"r"
07EF 71           1568             DB      71H             ;"F"
                  1569 ;
                  1570             END

USER SYMBOLS
ACID  0681    ACKN   075F    ACPNEW 0693    ACPSEN 06BB    ACPTD1 0687
ACPTID 0685   ADDSET 00F1    BCDPTR 0041    BCNT   0021    BCOUNT FFD3
```

```
IN1     0285    BINBCD  027D    BINPTR  0043    BKDIS2  050B    BKTST1  0272
KTST2   027C    BLCNT   006E    BLKDIS  0500    BNKTST  026E    BUSFRE  026D
AL _    00E5    CLKTIM  003B    CLOSED  0000    CLRDAT  001C    CNT1    FFFD
NT2     FFD3    COUNT   00A5    COUNT1  00FA    COUNT2  0078    DAT1    047E
AT2     0485    DAT2A   0489    DAT3    048B    DAT4    0499    DAT5    04A1
ATE     04A5    DATCON  0600    DATLOW  003F    DATOUT  0472    DCOUN1  FFFE
ECO0    0424    DECO1   0402    DECO2   044A    DECO2B  044C    DECO4   045B
ECO5    045D    DECODE  0400    DELAY   02B7    DETCT1  0516    DETECT  050E
FLAG    0070    DSBUF   002E    DSCMD   0090    DSEL    0007    DSPL1   070E
SPLAY   0700    DSTAT   0071    DSWR1   0728    DSWR2   071C    DTIME   0077
VALID   004B    EXTINT  00FD    FAILB   0073    FORE    008A    FORE0   0094
ORE0A   00AE    FORE1   00BA    FORE2   00BC    FORE3   00CE    FOREA   00AC
OREB    00AE    GDLY    FFC4    GLIGHT  0020    GTEST   04B9    GTEST1  04D4
TEST2   04DD    HFBIT   004C    IDADD   0020    IDBUF   004D    IDCLR   0052
DCNTL   004A    IDFLG   007E    IDLEC2  007D    IDLECT  007C    IDQUE   006D
DTIME   FF83    IDTS2   05AA    IDTST   0593    INBUF   0035    INIT51  0020
NIT79   0034    INPTR   0034    INTS1   01B3    INTS2   01C8    INTST   01AF
EYBLK   00D0    KEYCA   00FD    KEYCMD  0002    KEYDA   00FC    KEYPSC  0020
PBLK    050E    NEWDAT  0046    NOPRS1  053D    NOPRS2  0574    NULCOW  06AD
ULCW1   06B9    OFCNT   FFFE    OFDLY1  007A    OFDLY2  007B    OFF     0000
LDBUF   0028    OLDDAT  0048    ON      00FF    ONCNT   FFFE    ONDLY1  0078
NDLY2   0079    OPEN    00FF    OUTBUF  0022    OUTS1   04B0    OUTS2   04B4
UTS3    04B8    OUTST   04A6    PARITY  0045    POP     029B    POP1    02A1
OP2     02B5    PREAMB  003E    PRESST  0074    PSTATE  0072    PUSH    061D
USH1    0631    PWRLIT  0040    RAMT    007F    RDBIT   024A    RDBIT1  0255
DHB1    02EA    RDHBIT  025D    RDWD1   021D    RDWD2   0227    RDWD3   022C
DWD4    0247    RDWORD  0200    REGB0   0000    REGB1   0018    REMCOW  069D
EPEAT   0754    RIGHTU  00F9    RSEN2   0551    RSTAT   02C2    SSTAT   02CA
T90     065D    ST91    0671    ST92    0679    ST93    067D    STACK   0008
TART    0009    STATUS  006F    STEST   02D2    STEST1  02ED    STEST2  02F1
TRT1    001E    STTB0   0643    STTB1   0652    STTBL   0632    STTBL1  06EC
EST1    0588    TIM2A   0126    TIM2B   0130    TIM2C   0128    TIMEA   0175
IMEB    017A    TIMEBA  0191    TIMEC   0193    TIMED   019D    TIMEH   00F5
IMEL    0042    TIMIN1  011C    TIMIN2  0124    TIMIN3  0145    TIMIN4  015B
IMIN7   01AD    TIMIN8  01AD    TIMINT  0100    TNOFF   0462    TRAN1   0731
RAN2    073E    TRAN3   074A    TRAN4   073D    TRCNT   FFFE    TRCNTR  0075
JRNON   045E    UARTCA  00FB    UARTCM  0015    UARTDA  00FA    UARTL   003C
ARTMD   009A    XFER    0467    XFER1   046D    XMIT    0730

SSEMBLY COMPLETE,    NO ERRORS
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We claim:

1. An electronic identification system for identifying an object moving through a portal structure comprising:

at least one generating means for generating a multi-directional electromagnetic field in a plurality of different angular relations to the direction of movement of the object through the portal structure;

at least one first receiving means for attachment to the object for receiving and storing energy from the electromagnetic field;

at least one transmission means for attachment to the object for transmitting identifying data after the at least one first receiving means has received energy from the electromagnetic field;

at least one second receiving means for receiving the identifying data from the object; and

a flexible curtain secured to the portal structure, wherein the at least one generating means and the at least one second receiving means comprise an antenna loop secured to the flexible curtain.

2. The system of claim 1 comprising separate detector means for detecting the presence of the object within the portal structure.

3. The system of claim 2 wherein the separate detector means comprises an ultra-sonic transducer at the entrance to the portal structure and an ultra-sonic transducer at the exit to the portal structure whereby the separate detector means can determine the direction of movement of the object through the portal structure.

4. The system of claim 2 and including a microprocessor for controlling the at least one generating means, the at least one first receiving means, the at least one transmission means, the at least one second receiving means and the separate detector means.

5. The system of claim 1 wherein the curtain has pocket flaps and comprising stiffener plates located in said flaps for strengthening the curtain and for maintaining the proper angular orientation of the antenna loop.

6. The system of claim 1 further for identifying a plurality of objects, wherein individual objects move through one of a plurality of portal structures, the system comprising:

a plurality of generating means;

a plurality of first receiving means, each for attach-

ment to individual objects;

a plurality of transmission means, each for attachment to individual objects;

a plurality of second receiving means; and

a plurality of flexible curtains, each of the flexible curtains being secured to individual portal structures, and each of the generating means and the second receiving means comprising an antenna loop secured to individual flexible curtains.

7. The system of claim 6 also comprising microprocessor control means for controlling the plurality of generating means, the plurality of first receiving means and the plurality of second receiving means, wherein the microprocessor control means determines whether individual generating means and individual second receiving means are activated at a given point in time.

8. An electronic identification system for identifying an animal moving through a portal structure comprising:

a parallel resonant circuit connected to the portal structure including a double antenna loop for alternately generating a multi-directional electromagnetic field in a plurality of different angular relations to the direction of movement of the object through the portal structure and receiving identifying data concerning the animal;

a flexible curtain attached to the portal structure, said loop being located in said curtain;

a transponder adapted to be worn by the animal for receiving energy from the electromagnetic field and, when the electromagnetic field is removed, for transmitting the identifying data to the first parallel resonant circuit; and

separate detector means for detecting the presence and direction of movement of the animal as the animal moves through the portal structure.

9. The system of claim 8 wherein the curtain has pocket flaps and comprising stiffener plates located in said flaps for strengthening the curtain.

10. The system of claim 8 wherein the separate detector means comprises at least one ultra-sonic transducer.

* * * * *